THE

JOURNAL

OF THE

ROYAL GEOGRAPHICAL SOCIETY.

VOLUME THE TWENTY-THIRD.

1853.

EDITED BY DR. NORTON SHAW.

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JOHN MURRAY, ALBEMARLE STREET.

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CONTENTS OF VOL. XXIII.

[N.B. The Authors are alone responsible for the contents of their respective papers.]

ILLUSTRATIONS.

Royal Geographical Society.

1853.

REPORT OF THE COUNCIL,

READ AT THE ANNIVERSARY MEETING, 23RD MAY.

THE Council have the pleasure to submit their customary Report, and to invite attention to the evidence afforded by it of increased public interest in the objects for which the Society was instituted, namely, the promotion and diffusion of Geographical knowledge.

Members,—Ordinary, Honorary, and Corresponding.—Since the last anniversary meeting 105 ordinary members have been added to the lists of the Society, a number greatly in excess of any previous year. One *Honorary* and one *Corresponding* member have also, upon the recommendation of the Council, been duly elected, viz. :—M. Piérre de Tchihatchef, author of important works on the Altai Mountains and Asia Minor, and Sig. Cristoforo Negri, Chief of the Consular department of Sardinia, and author of the work entitled "Del vario grado d'importanza degli Stati Odierni." During this period 16 vacancies have occurred among the ordinary members, of which 12 from death, and 4 by resignation. Of honorary and corresponding members the Council have also to notice with regret the decease of the illustrious geologist and geographer, Leopold von Buch; the distinguished Danish

hydrographer, Admiral Zahrtmann, of Copenhagen; and General Joaquin Acosta of Bogotâ.

The Society now consists of 701 ordinary, and 62 honorary and corresponding members.

Finances.—The funded capital of the Society, consisting of 2000*l.* 3½ per cent. Government Stock, continues intact.

The receipts of the past year, which were estimated at 1342*l.* 13*s.* 10*d.*, amounted, as is shown in the accompanying Balance Sheet, to 1540*l.* 14*s.* 6*d.*; from which amount must however be deducted 38*l.* 5*s.* received in aid of the recent Arctic Expedition, and since paid over to Lady Franklin.

The progressive increase of the Society's income has enabled the Council to make good some Library deficiencies, and to improve many details of scientific arrangement. Last year a Catalogue, prepared with much ability and care by our excellent Assistant Secretary, Dr. Shaw, was printed, and the Society's valuable collections of Books, Maps, and Charts are now available, as far as our limited space admits, to its members. This year the same zealous officer is revising for publication a general Index to the Journals, vols. 10 to 20 inclusive, compiled and presented to the Society by Mr. George Brent, which will also be issued to the Fellows *free of charge.*

Arrears.—At the last anniversary it was decided to strike off from the lists of the Society the names of all members in arrear of subscriptions for periods exceeding three years; this has accordingly been done, and 37 defaulters, representing an aggregate arrearage of 644*l.*, have, in consequence, ceased to be Fellows of the Society.

In order to meet the requirements of scientific travellers going abroad, or members ordered on foreign service, the Council, after

mature consideration, recommend that, upon due notice to the Secretary *in writing*, the names of all such members be retained upon the lists of the Society during their residence abroad, without requiring payment of the customary subscriptions; and further, that, upon payment of a reduced annual subscription of 1*l.*, such members shall be entitled to the Journals, or other free publications of the Society, during the periods of their foreign residence, in the same manner as if paying the customary full subscription.

Publications.—The 22nd volume of the Journal has been published since the last anniversary; and continues to be delivered *free*, on application at the Society's rooms, to all members whose subscriptions are not in arrear. The Council think they may fairly congratulate the Society on the increased attraction of this publication,—the number, variety, and value of the articles, and the illustrations which accompany them. The sales to the public show a corresponding improvement, the bookseller's returns, from 1847 to the year under consideration, ranging from 30*l.* to upwards of 120*l.*

The 23rd volume, which it is confidently hoped will not yield in interest to any preceding number, is now in preparation, and will be published in the course of the present year.

The Libraries of the Geographical Society at New York, the Canadian Parliament at Quebec, and the Armenian Convent, St. Lazare, at Venice, have been added to the list of Institutions to which the Journals of the Society are presented.

Administration.—In order most efficiently to carry out the objects of the Society, the Council is now divided into permanent working Committees under the following heads:—

1st. Regulations and Bye-Laws.
2nd. Finance and House.
3rd. Library, Maps, &c.
4th. Publications.
5th. Expeditions.

Without entering upon the various subjects referred for investigation during the past year, and reported upon to the Council for final decision, it may be noticed that a valuable paper has been drawn up by the Committee on Expeditions, entitled "Hints for Travellers," which will be published in the next volume, and which will also be printed separately for general distribution.

Library.—Since the last anniversary 156 volumes of Books have been bound, and 436 sheets of Maps and Charts have been mounted. In the same period the accessions to the Library comprise 438 volumes of Books and Pamphlets, 19 Atlases, and 400 Sheets of Maps and Charts, a list of which is laid upon the table, and will be printed in the Journal. Among other important contributions during the past year may specially be noticed the following:—Owen's Report of a Geological Survey of Wisconsin, Iowa and Minnesota, &c., with accompanying Illustrations, 4to.; Schoolcraft's History, Condition, and Prospects of the Indian Tribes of the United States, vol. 2, 4to.; Smithsonian Contributions to Knowledge, vols. 3 and 4, Imp. 4to.; Stansbury's Exploration and Survey of the Great Salt Lake of Utah, 8vo., with accompanying Maps and Illustrations; Tchihatchef's Asia Minor, &c., with Maps and Engravings; Ritter's Atlas of Asia, 5 sheets; Ancient Atlases, Maps, and Charts, presented by the Lords of the Treasury, and others by His Grace the Duke of Manchester; Transactions of the Imperial Geological Institute of Vienna; Atlas, containing 36 sheets of the Topographical Surveys of Prussia, from Messrs. Schropp of Berlin; Map of the

Island of Cuba, by Don Estéban Pichardo; Original Ancient Map of Central America, by Geronimo de Chaves, presented through Dr. Hodgkin by Timothy Bevington, Esq.; Transactions of the Lombardo-Veneto Institute of Milan, and of other Foreign Bodies; Continuation of the Topographical Maps of the Cantons of St. Gall and Appenzell, Geological Map of Switzerland, and A General Atlas of Geography, presented by Mr. J. M. Ziegler, of Winterthur; and Charts published by the Hydrographic Office of the Admiralty.

Royal Donation.—The Gold Medals, forming the annual donation of Her Most Gracious Majesty, have been awarded as follows:—

The Founder's Medal to Francis Galton, Esq., for having, at his own cost, and in furtherance of the expressed desire of the Society, fitted out an expedition to explore the centre of Southern Africa, and for having so successfully conducted it through the countries of the Namaqua, the Damara, and the Ovampo (a journey of about 1700 miles), as to enable this Society to publish a valuable memoir and map in the last volume of the Journal relating to a country hitherto unknown; the Astronomical Observations, determining the latitude and longitude of places, having been most accurately made by himself.

The Patron's Medal to Commander Edward Augustus Inglefield, of the Royal Navy, for his very remarkable and enterprising Survey of the Coasts of Baffin Bay, Smith Sound, and Lancaster Sound, in the last summer, during which he threw much new light on the geography of the Arctic Regions, and, with the very limited means at his disposal, accomplished most important results.

The Council would gladly close their Report without touching

upon an ungrateful theme,—the want of suitable Apartments for needful display of the Society's Maps and Charts, and for discussion of the various papers submitted to the Sessional Meetings.

This want is the more felt in proportion to the increased public attention recently accorded to the Society. Maps and Charts of the highest interest to every one engaged in foreign and colonial trade or policy are hidden for lack of space; and crowded Meetings are held, by sufferance, at the rooms of another institution, where the advantage of immediate reference to the Society's valuable collections and digests is altogether lost.

The Society is engaged in a department of science universally admitted to be of the first importance to mankind, and preeminently so to this great empire,—its labours are gratuitous, while the fruits of them are wholly national. Is it too much then to ask for such public aid, in the shape of suitable apartments or the means to procure them, as may remove the hindrances that at present so greatly impede its career of usefulness? The Council consider the Society has a just claim to public support in return for public services; and they have not failed to urge such claim upon successive Governments, which claim has been virtually admitted, but remains as yet without practical results.

BALANCE-SHEET FOR THE YEAR 1852.

Receipts.

	£. s. d.	£. s. d.
Subscriptions of 234 Fellows		468 0 0
Entrance of 60 Fellows		180 0 0
Composition of 6 Fellows		148 0 0
Arrears of Subscriptions paid up		86 0 0
Journals and Indices sold		122 15 8
Dividends on 2000*l.* of $3\frac{1}{4}$ per Cent. } Income Tax deducted.		63 2 2
,, on 224*l.* 1s. 10*d.* of 3 per Cent. } Income Tax deducted.		6 10 6
Royal Premium		52 10 0
Mr. Greenough's Donation to Catalogue		50 0 0
Amounts paid into Banker's towards Arctic Expedition		38 5 0
Sundries overpaid		3 0 0
Captain Dundas's Donation to Library		2 0 0
Total Income for the year 1852		1,220 3 4
Balance at Banker's, January 1, 1852	£287 16 0	
,, in the Secretary's hands	32 15 2	320 11 2
		£1,540 14 6

Expenditure.

	£. s. d.	£. s. d.
Journal—Printing Vol. XXI.	169 11 6	
,, ,, Catalogue	91 14 10	
,, For preparing Catalogue	50 0 0	
,, Illustrations	8 18 9	320 5 1
Salaries—A.-Secretary and Editor	200 0 0	
,, Clerk	50 0 0	
,, Collector	9 5 0	
Wages—Messenger and Housemaid	40 0 0	299 5 0
House Rent and Fixtures, 3 quarters*		197 14 9
Office Expenses:—		
Postages (including Stamps, Freight, Duty, Carriage of Parcels, &c.)	28 2 8	
Firing and Lights	16 12 10	
Stationery	11 8 5	
Evening Meetings	6 7 3	62 11 2
Royal Premium (Medals)	..	47 9 0
Furniture and Repairs	..	18 16 9
Insurance and Advertisements	..	16 4 0
Sundry Petty Charges	..	11 18 7
Books and Binding	..	11 8 9
British Association Meeting	..	10 0 0
Total Expenditure for the year 1852	..	995 13 1
Balance at Banker's, Dec. 31, 1852	522 6 3	
,, in the Secretary's hands	22 15 2	545 1 5
		£1,540 14 6

* The Christmas quarter's rent was paid in Dec. 1852, but was not drawn from Banker's until Jan. 1853.

ROBERT BIDDULPH, *Treasurer*.

Examined and found correct.

E. OSBORNE SMITH, } *Auditors*.
THOS. LEE, }

ESTIMATE FOR THE YEAR 1853.

Receipts.

				£.	s.	d.	£.	s.	d.
Banker's and Petty Cash Balances				515	1	5			
Less, Cheques issued for 1852	£93	17	0						
,, Subscription for Arctic Expedition	38	5	0						
				132	2	0			
							412	19	5
Annual Subscriptions of 275 Members at 2*l*. each				..			550	0	0
Compositions of 6 Members at 25*l*. each				..			150	0	0
Entrance Fees of 50 Members at 3*l*. each				..			150	0	0
Arrears, estimated to be paid				..			50	0	0
Sale of Journals and Indices				..			100	0	0
Dividends on 2000*l*. 3¼ per cent. Stock				..			63	2	2
Royal Premium				..			52	10	0
							£1,528	11	7

Expenditure.

	£.	s.	d.	£.	s.	d.
Journals, including Illustrations	350	0	0			
Index, Vols. 10 to 20 incl.	50	0	0			
				400	0	0
Rent and Fixtures	..			300	0	0
Salaries and Wages	..			350	0	0
Library Expenditure	..			100	0	0
Office Expenses	..			100	0	0
Royal Premium	..			52	10	0
Furniture and Repairs	..			50	0	0
Miscellaneous Printing	..			50	0	0
Insurance and Advertisements	..			30	0	0
Balance applicable to Sundries	..			96	1	7
				£1,528	11	7

NORTON SHAW.

Library Regulations.

I. The Library shall be open every day in the week (Sundays excepted) from *Eleven* in the morning to *Five* in the afternoon, except on New Year's Day, Good Friday to Easter Monday inclusive, and Christmas week; and it shall be closed one month in the year, in order to be thoroughly cleaned, viz. from the first to the last day of September.

II. Every Member of the Society shall be entitled (subject to the Rules) to borrow as many as four volumes at one time.

Exceptions:

1. Dictionaries, Encyclopædias, and other works of reference and cost, Minute Books, Manuscripts, Atlases, Books and Illustrations in loose sheets, Drawings, Prints and unbound Numbers of Periodical Works, *unless with the special written sanction of the President.*
2. Maps or Charts, *unless by written order of the President, Council, or Secretaries.*
3. New Works before the expiration of a month after reception.

III. The title of every Book, Pamphlet, Map, or Work of any kind lent, shall first be entered in the register, with the borrower's signature, or accompanied by a separate note in his hand.

IV. No work of any kind shall be retained longer than one month; but at the expiration of that period, or sooner, the same shall be returned free of expense, and may then, upon *re-entry*, be again borrowed, provided that no application shall have been made in the mean time by any other Member.

V. In all cases a list of the Books, &c., or other property of the Society, in the possession of any member, shall be sent in to the Secretary *on or before the 1st of July in each year.*

VI. In every case of loss or damage to any volume, or other property of the Society, the borrower shall make good the same.

VII. No stranger shall be admitted to the Library except by the introduction of a Member, whose name, together with that of the Visitor, shall be inserted in a book kept for that purpose.

VIII. Members transgressing any of the above Regulations shall be reported by the Secretary to the Council, who will take such steps as the case may require.

By Order of the Council,

NORTON SHAW.

December 9, 1850.

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Australasia, Map of (in Armenian characters). 1849. Armenian Convent, Venice.

Australia, E. Coast. Sheets 1 to 4 incl. 1851.

——— Botany Bay and Port Hacking. 1848-51.

——— Broken Bay.

——— Jervis and Bateman Bays. 1851.

——— Gulf of St. Vincent, Troubridge Shoals. 1851. Hydrographic Office.

Maps, Charts, &c. *Donors.*

CHINA SEA, corrected to 1853.

——— BORNEO.—Bruni River, entrance to the. Borneo. 1845-49.

——— Carimata Strait.

——— Banca and Gaspa Straits.

——— Gaspar Strait, with its three Channels.

——— Royalist Haven. 1847.

——— Tambelan Islands, and St. Esprit Group. HYDROGRAPHIC OFFICE.

——— JAVA.—De Eilanden Beoosten Java van Bali tot Timor. By Jacob Swart. 2 Sheets. Amsterdam, 1853. The AUTHOR.

PACIFIC.—SOCIETY ISLANDS.—Owaarre Harbour, in Huaheine Island. 1852.

——— Tasmania, Port Davey. 1850.

TERRA AUSTRALIS, Chart of. By M. Flinders. South Coast. Sheet 3. 1802. Corrected to 1853. HYDROGRAPHIC OFFICE.

ARCTIC.

ARCTIC SEA.—Baffin Bay. Sheet 1. 1853.

——— Barrow Point and Port Moore. 1852-53.

——— Behring Strait. Sheet 3. 1853.

——— Discoveries in the, to 1852. HYDROGRAPHIC OFFICE.

CHART of the American Arctic Expedition in search of Sir John Franklin. Washington, 1851. SMITHSONIAN INSTITUTION.

CHART of the Arctic Regions, showing the recent discoveries, and illustrating Dr. Sutherland's account of an Expedition, under the command of Capt. Penny, in search of Sir John Franklin, 1850-51. By A. Petermann, F.R.G.S. 1852. The AUTHOR.

ARCTIC Sea, Chart of the Discoveries in the, up to 1852. HYDROGRAPHIC OFFICE.

POLAR Chart, illustrating Dr. Sutherland's account of Capt. Penny's Expedition, 1850-51, &c. By A. Petermann, F.R.G.S. 1852. The AUTHOR.

MEDITERRANEAN.

MEDITERRANEAN SEA, with 3 Plans. 1852.

MINORCA, Port Mahon, in the Island of. Corrected to 1852. HYDROGRAPHIC OFFICE.

NORTH SEA.

ESTUARY of the Elbe, as far as the Island of Heligoland. By S. G. Zimmermann. Hamburg, 1721.

ESTUARY of the Elbe, with the Island of Heligoland and the surrounding Seas. Hamburg, 1767.

SPECIAL Charte der Küstenländer der Nordsee an den Mündungen der Weser, Jahde und Elbe nebst Umgebungen der Hanse-Städte Hamburg, Lübeck und Bremen. 8 Sheets. Weimar, 1811. The TREASURY.

RED SEA.

RED SEA, Chart of the, from Jiddah to the Straits of Bab-El-Mandeb, surveyed in the years 1830-1-2 and 3, by Capt. T. Elwon and Lieut. H. N. Pinching, and completed by Commander R. Moresby, I.N. 4 Sheets. The Hon. EAST INDIA COMPANY.

MISCELLANEOUS.

Maps, Charts, &c. *Donors.*

BACK, SIR GEORGE, Portrait of, in oil colours. (Placed, by permission of the Council, under Lady Back's care.) W. BROCKEDON, Esq., F.R.S., F.R.G.S.

IQUIQUE, South Peru, view of. By George Smith. WILLIAM BOLLAERT, Esq., F.R.G.S.

LEOPOLD VON BUCH, Hon. F.R.G.S., Lithograph Portrait of. Messrs. SIMON SCHROPP and Co., Berlin.

ORIENTAL and other Types, in 67 languages or dialects, principally prepared by the late Mr. R. Watts, and now in use in W. M. Watts's office, Crown Court, Temple Bar. (On roller.) 1 Sheet. THOMAS HODGKIN, Esq., M.D., F.R.G.S.

SKETCHES in Australia, from drawings by R. M. Westmacott, Esq., F.R.G.S., late Captain 4th King's Own Regiment. Imp. 4to. The AUTHOR.

Two Views in Lithograph of H.M.S. 'Rattlesnake' and 'Bramble' tender, commanded by Capt. Owen Stanley, R.N.:—No. 1. 'Finding an entrance through the Reefs into the Louisiade Archipelago.' No. 2. 'Entering the Louisiade Archipelago, June 14th, 1852.' By O. W. Brierly, F.R.G.S. Framed. The AUTHOR.

CHRONOMETERS AND INSTRUMENTS.

*(Those marked * have been lent to Dr. P. C. Sutherland at Natal.)*

No.		No.
1.	Box Chronometer, by Barraud and Lund	825
2.	Box do., by Do.	655
3.	Box do., by Molyneux	2482
*4.	Pocket do., by Brockbank and Atkins	835

*5. Portable Altitude and Azimuth Instrument, by Robinson.
6. Six-inch Reflecting and Repeating Circle.
7. Ebony and Brass Clinometer, by Thomas Jones.
8. Case of Mathematical and Drawing Instruments.
9. Case of Surgical Instruments.
10. Brass Triangular Graduated Charto-meter, by Eitel.
11. Brass Box Pocket Compass, 2½-inch needle.
12. Large Brass Pentagraph, by Troughton.
13. Small do., by Bleuler.
14. Set of Graduated Box Scales, by Troughton and Simms.
15. Bulb Hygrometer for Ether, by W. and S. Jones.
*16. Brass Sextant (7½-inch), with Silver Limb, by Troughton and Simms.
17. Do. divided on gold, by Dollond.
18. Tripod Brass Stand and Counterpoises for Sextant.
19. Ebony Sextant, with Ivory Limb, 9-inch.
20. An 8-inch Box Azimuth Compass, with Sight Vanes and Cards in a separate box.
*21. Strong-framed Artificial Horizon, by Troughton and Simms.
22. Theodolite (5-inch), divided on Silver, with Mahogany Stand, by Troughton and Simms.
23. Small Medicine Chest.
24. Brass Station Pointer, with Lengtheners, by Troughton and Simms.
*25. Prismatic Pocket Compass, by Troughton and Simms.
26. Marine Barometer, by Troughton and Simms.
*27. Thermometrical Boiling Water Apparatus, for Heights.
28. Case of Wooden Ruling Scales.
29. Achromatic Telescope (3½ feet), 2 inches aperture.
30. Sliding Tube Do. (3 feet), 1¾ inches aperture.
31. Night, or Comet-Sweeping Telescope, 2 feet focus, and 5 inches aperture.
32. Set of Magnets.
33. Mountain Barometer, by Troughton and Simms.
*34. Two Newman's Improved Iron Cistern Mountain Barometers.
35. Another ditto.
36. Square-framed Mountain Barometer, by Newman.
37. Mountain Barometer, by Troughton and Simms, with Tripod Stand.
38. Dipping Instrument.
39. Telescope,
40 and 41. Two Compasses,
42. Aneroid Barometer,
} Lent to Mr. Duncan, Vice-Consul at Whydah, in 1849, and not yet returned.

Proceedings of the Royal Geographical Society of London.

SESSION 1852–53.

First Ordinary Meeting, November 8, 1852.

The President, Sir RODERICK I. MURCHISON, in the Chair.

Sir Henry Mervyn Vavasour, Bart.; Rev. Sir Henry R. Dukinfield, Bart.; Capt. J. E. Erskine, R.N.; Dr. F. W. S. Packman, M.D.; John Dickenson, Esq., jun.; William Henderson, Esq.; R. S. Illingworth, Esq.; and W. Foster White, Esq., were elected Fellows.

The Papers read were—

1. Capt. Kennedy on his return from the Arctic Regions, with Lady Franklin's vessel, the Prince Albert; and Lieut. Bellot's letter to Dr. Shaw.

2. Abstracts of letters received from Commander E. A. Inglefield of the Isabel screw schooner, and Capt. Maguire of the Plover.

3. Mr. A. Petermann, F.R.G.S., on the Whale Fisheries in the Arctic Seas.

The President called attention to the value of the 22nd volume of the Journal, which had been that day published by the Secretary, and which would, as usual, be delivered, upon application, *free* to the Fellows of the Society.

Second Ordinary Meeting, November 22, 1852.

The President, Sir RODERICK I. MURCHISON, in the Chair.

The Marquis of Breadalbane, K.T.; Dr. R. G. Latham, M.D.; Henry Browning, Esq.; John Watkins, Esq.; Lieut.-Col. A. A. T. Cunynghame, 27th Regt.; Major H. S. Rowan, R.A.; Capt. B. Wade; W. Cotton Oswell, Esq.; Lieut. Thomas Saumarez, R.N.; Lieut. J. W. Pike, R.N.; Lionel Gisborne, Esq., C.E.; T. Stubbs, Esq.; Thomas Forester, Esq.; James Talboys Wheeler, Esq.; and James Glenie Price, Esq., were elected Fellows.

The Paper read was—

Commander E. A. Inglefield, F.R.G.S., of the Isabel, on his return from the Arctic Regions.

Third Ordinary Meeting, December 13, 1852.

The President, Sir RODERICK I. MURCHISON, in the Chair.

Capt. Henry Strachey; Lewis Powell, Esq., M.D.; and Walter McLeod, Esq., were elected Fellows.

The Papers read were—

1. Survey of the Sea of Aral, by Capt. Butakof, of the Imp. Russian Navy.

2. Surveys in Western Tibet, by Capt. Henry Strachey, for which the Patron's Gold Medal was awarded.

Fourth Ordinary Meeting, January 10, 1853.

The President, Sir Roderick I. Murchison, in the Chair.

Sir Peregrine P. F. P. Acland, Bart.; Lieut.-Gen. Sir George Pollock, G.C.B.; Richard Monckton Milnes, Esq., M.P.; Rev. Thos. W. Jenkyn, D.D.; Capt. Wm. Moorsom, R.N.; Commander Peter Cracroft; Commander Thomas Miller; Dr. John Rae; John Coningham, Esq.; and James Tilleard, Esq., were elected Fellows.

The Papers read were—

1. An attempt to account for numerous appearances of Sudden Drainage on the Sides of the Basin of the Dead Sea, by Capt. Wm. Allen, R.N., F.R.S., F.R.G.S.

2. Outlines of a Journey in Palestine in 1852, by the Rev. Dr. E. Robinson and others.

Fifth Ordinary Meeting, January 24, 1853.

The President, Sir Roderick I. Murchison, in the Chair.

Richard T. Gore, Esq.; R. Newton Hayward, Esq.; Capt. John H. Lefroy, R.A.; James Loch, Esq.; Joseph Reynolds, Esq.; Albert Robinson, Esq., C.E.; Bethel H. Strousberg, Esq.; and George Ward, Esq., were elected Fellows.

The Papers read were—

1. Ascent of the Upper Nile, by Mr. Brun-Rollet, communicated by Sig. Christoforo Negri of Turin, Cor. F.R.G.S., with remarks by Mr. Macqueen, F.R.G.S.

2. Traject across Africa, by a Moorish Caravan from Zanzibar to Angola, with Notes, by Mr. Cooley, F.R.G.S.

3. An account of two Expeditions made into Central Africa, by the Furanys, communicated by Dr. Barth through Dr. Beke, F.R.G.S.

Sixth Ordinary Meeting, February 14, 1853.

The President, Sir Roderick I. Murchison, in the Chair.

J. Silk Buckingham, Esq.; Capt. Fortescue Harris; Capt. George Hand, R.N.; Peter Levesque, Esq.; Henry Sewell, Esq.; Capt. W. H. Walker; and Arthur Westmacott, Esq., were elected Fellows.

The Papers read were—

1. Abstract of Letters received from Mr. Ladislaus Magyar, dated April 20, 1851, Sah-Quilem, on the River Kaszabi, in the Kingdom of Kalunda, in Central Africa, S. lat. 4° 41′, and E. long. 23° 43′, translated by Dr. H. Rónay.

2. Remarks on the Country between Seleucia, the Valley of the Orontes, Antioch, and Apimere, to Belís on the Euphrates, by Dr. Thompson.

3. Remarks on the Watershed of the Wadi-el-Arabá, by Capt. Wm. Allen, R.N., F.R.S., F.R.G.S.

The President particularly directed the attention of the Meeting to the valuable present of Atlases, Maps, and Charts which, by the permission of

the Lords of the Treasury, had been presented, through Sir Charles E. Trevelyan, to the Society.

Seventh Ordinary Meeting, February 28, 1853.

The President, Sir RODERICK I. MURCHISON, in the Chair.

Capt. Edward Barnett, R.N.; Rev. Brymer Belcher; Sir Edward North Buxton, Bart.; Dr. Edward Cullen; R. W. Grenfell, Esq.; Charles Mallet, Esq.; Sir George Osburn, Bart.; Alexander Peckover, Esq.; Dr. Philip Pusey; and Dr. George Sexton, were elected Fellows.

The Papers read were—

1. Mines of Copiapo, by Colonel J. A. Lloyd, F.R.S., F.R.G.S., H.B.M.'s Chargé d'Affaires in Bolivia, communicated by H.R.H. Prince Albert, through Sir R. I. Murchison.

2. Report of a Canoe Expedition along the East Coast of Vancouver Island, by Governor J. Douglas, communicated by the Colonial Office.

3. Note on part of Queen Charlotte Islands, in the North Pacific, with specimens of the Gold-bearing-Quartz from Una Point, Mitchell Harbour, Middle Island.

The President directed attention to the present of Ancient Atlases from his Grace the Duke of Manchester, and to a bust of the lamented African traveller, Mr. James Richardson; and alluded also to the further loss the expedition had sustained in the recent death of Dr. Overweg, whose investigations in African geology and meteorology would, he hoped, soon be made known to the public.

Eighth Ordinary Meeting, March 14, 1853.

The President, Sir RODERICK I. MURCHISON, in the Chair.

M. I. Brickdale, Esq.; Capt. R. Gordon, R.N.; Capt. the Hon. E. Harris, R.N.; G. H. Strutt, Esq.; and Capt. S. E. Widdrington, R.N., were elected Fellows.

The Paper read was—

Capt. R. Fitz Roy, R.N., F.R.S., F.R.G.S. Further Considerations on the Great Isthmus of Central America.

The President announced that he had directed cards of invitation to his soirées, on the 21st of March and the 4th of April, to be sent to the Fellows of the Society, and expressed a hope to see a numerous attendance at his house on those occasions.

Ninth Ordinary Meeting, April 11, 1853.

The President, Sir RODERICK I. MURCHISON, in the Chair.

M. Pierre de Tchihatchef was elected an Honorary Member, and

The Earl of Gifford; Capt. W. H. Hall, R.N.; John Henderson, Esq.; G. A. Hoskins, Esq.; Robert Lowe, Esq., M.P.; and George Peacock, Esq., were elected Fellows.

The Paper read was—

Oceanic Currents, and their connection with the proposed Central-America Canals, by Mr. A. G. Findlay, F.R.G.S.

Tenth Ordinary Meeting, April 25, 1853.

The President, Sir RODERICK I. MURCHISON, in the Chair.

Henry Bourne, Esq.; C. Chidley Coote, Esq.; Viscount Goderich; J. M. Haldon, Esq.; Rev. D. Halkett; Dr. E. G. Irving, R.N.; E. R. Simmons, Esq.; George Smith, Esq., of Peru; H. S. Southey, Esq.; and his Grace the Duke of Wellington, were elected Fellows.

The Papers read were—

1. Extracts from a Journal up the Koladyn River (Aracan), with Description of the Scenery, Topography, Inhabitants, and Products of the Country, by Capt. S. R. Tickell, B.N.I.

2. Notes from an Excursion to the supposed Tombs of Ezekiel, and the neighbourhood of the sacred Cities of Najif and Kerbelah, through the Marshes W. of the Euphrates, by Thos. Kerr Lynch, Esq., communicated by Col. Rawlinson, C.B., F.R.G.S.

The President announced that the Council had awarded the two Gold Medals of the year to Francis Galton, Esq., for his valuable explorations in Southern Africa; and to Commander Edward Augustus Inglefield, for his recent Arctic surveys.

Eleventh Ordinary Meeting, May 9, 1853.

The President, Sir RODERICK I. MURCHISON, in the Chair.

Prof. D. T. Ansted; James Ashwell, Esq., C.E.; the Right Hon. E. Cardwell, M.P.; the Right Hon. the Earl of Clarendon, K.G.; Capt. the Hon. F. Egerton, R.N.; Capt. Oct. Vernon Harcourt, R.N.; John Holmes, Esq., of the British Museum; Sir Ralph Howard, Bart.; Sir John V. B. Johnstone, Bart., M.P.; Edward Porter, Esq.; Lord Stanley, M.P.; Count P. E. de Strzelecki; and the Right Hon. Sir Charles Wood, Bart., M.P., were elected Fellows.

The Papers read were—

1. On the large Continental Ice-masses of Greenland, and the origin of the Icebergs in the Arctic Seas, by Dr. H. Rink of Copenhagen, communicated by Dr. Shaw.

2. The Mining prospects of Greenland, by J. A. Lundt, Esq., communicated by Sir Walter C. Trevelyan.

ANNIVERSARY MEETING, 1 P.M., MAY 23, 1853.

(Held at the Royal Institution, Albemarle Street.)

The President, Sir RODERICK I. MURCHISON, in the Chair.

The Minutes of the previous Meeting having been read and confirmed, the Regulations respecting the Anniversary Meetings were read, when the President appointed Augustus Petermann and Trelawney Saunders, Esqs., Scrutineers for the Ballot.

Mr. J. M. Ziegler, of Winterthur (author of the Atlas of St. Gall and Appenzell, and of Maps of Switzerland, &c.), as a Corresponding Member; Sir Joseph W. Copley, Bart.; Sir Francis H. Doyle, Bart.; Lieut.-Col. Geo. T. Conolly Napier, C.B.; Right Hon. Sir

John Pakington, Bart., M.P.; Dr. James Price, M.D.; Prof. Edward Solly; Dr. W. R. Wagstaff; Capt. B. Williams; John G. Cole, Esq.; John Wm. Cunningham, Esq., Sec. King's College; George Moffat, Esq., M.P.; Charles Sevin, Esq.; George Tomline, Esq., M.P.; Edward W. Whinfield, Esq.; and Stuart Donaldson, Esq., of Australia, were proposed as Candidates for election at the next Meeting.

The Report of the Council, together with the Balance-sheet for 1852, and the Estimate for 1853, was read and adopted. The President then reported the grounds on which the Council had awarded the Royal Medals, "for the Encouragement of Geographical Science and Discovery," to Francis Galton, Esq., and Commander Edward Augustus Inglefield (see p. lviii.). The Anniversary Address was next read, when a unanimous vote of thanks was passed, with a request that the President would allow the Address to be printed.

At the conclusion of the Ballot the Scrutineers reported that the changes recommended by the Council had been adopted, and that the following had been duly elected:—

President.—The Right Honourable the Earl of ELLESMERE, D.C.L., F.S.A., F.R.A.S., &c. &c. &c.

Vice-Presidents.—Sir RODERICK I. MURCHISON, G.C.St.S., M.A., D.C.L., F.R.S., &c. &c.; Sir CHARLES FELLOWS; the Right Hon. Lord COLCHESTER, R.N., D.C.L.; Colonel PHILIP J. YORKE, F.R.S., &c.

Treasurer and ex-officio Trustee.—ROBERT BIDDULPH, Esq.

Trustees.—Sir GEO. T. STAUNTON, Bart., F.R.S.; W. R. HAMILTON, Esq., F.R.S.

Honorary Secretaries.—Capt. F. P. BLACKWOOD, R.N., F.R.A.S., and THOMAS HODGKIN, Esq., M.D., &c.

Council.—JOHN ARROWSMITH, Esq.; Sir GEORGE BACK, R.N., F.R.S.; Rear-Admiral Sir FRANCIS BEAUFORT, K.C.B.; Vice-Admiral WILLIAM BOWLES, C.B.; Rt. Hon. Sir DAVID DUNDAS; Lieut.-Col. G. EVEREST, F.R.S.; Capt. ROBERT FITZROY, R.N., F.R.S.; GEO. BELLAS GREENOUGH, Esq., F.R.S.; WM. JOHN HAMILTON, Esq., Sec. G.S.; Sir HENRY HOLLAND, Bart., M.D., F.R.S.; Sir WOODBINE PARISH, K.C.H., F.R.S.; Lieut.-Col. J. E. PORTLOCK, R.E., F.R.S.; HENRY RAPER, Esq., R.N., F.R.A.S.; Colonel EDWARD SABINE, R.A., F.R.S.; Right Rev. the BISHOP of ST. ASAPH; Right Hon. the Earl of SHEFFIELD; E. OSBORNE SMITH, Esq., F.S.A.; Rear-Admiral WM. H. SMYTH, K.S.F., D.C.L., F.R.S.; THOMAS STAVELY, Esq. (Foreign Office); Sir WALTER C. TREVELYAN, Bart., M.A.; Rev. W. WHEWELL, D.D., M.A., F.R.S.; Sir GARDNER WILKINSON, LL.D., F.R.S.

The thanks of the Meeting were next separately voted to the retiring President, Vice-Presidents, Hon. Secretary, and Members of the Council, as well as to the Auditors and Scrutineers.

The thanks of the Society were also unanimously voted to the "President and Authorities of the Royal Institution," for their kindness in

granting the use of the Theatre of that Institution for the Meetings of the Society during the past session.

The President finally directed the attention of the Meeting to the usual Anniversary Dinner, and the Meeting adjourned at 4 P.M.

Twelfth Ordinary Meeting, June 13, 1853.

Sir RODERICK I. MURCHISON, Vice-President, in the Chair.

Lieut. J. Bellot, of the Imp. French Navy; and Mr. J. M. Ziegler, of Winterthur, were elected Corresponding Members, and

Sir Joseph W. Copley, Bart.; Sir Francis H. Doyle, Bart.; Lieut.-Col. Geo. T. Conolly Napier, C.B.; Right Hon. Sir John Pakington, Bart., M.P.; Dr. James Price, M.D.; Prof. Edward Solly; Dr. W. R. Wagstaff; Capt. B. Williams; John G. Cole, Esq.; John Wm. Cunningham, Esq., Sec. King's College; George Moffat, Esq., M.P.; Charles Sevin, Esq.; George Tomline, Esq., M.P.; Edward W. Whinfield, Esq.; and Stuart Donaldson, Esq., of Australia, were elected Fellows.

The Papers read were—

1. Island of Chusan, by Sir John F. Davis, Bart., F.R.S., F.R.G.S., with Map.
2. Peninsula of Samaná in St. Domingo, by Sir R. H. Schomburgk, Corr. F.R.G.S., with Map, communicated by the Foreign Office.
3. Rio Negro and the Head-Waters of the Amazon, by Mr. A. R. Wallace, with Map.
4. Rio Maulé in Chili, by Capt. Walter Hall, with Map.
5. Excursion from the Atrato to the Bay of Cupica, by Commander Friend, communicated by Capt. Barnett, R.N., F.R.G.S.

The Chairman mentioned that a proposition made by Mr. Ernest Haug to explore Australia, having been examined by a Committee and undergone certain modifications, had been recommended to the Council, which had referred the modified plan for further consideration to the "Committee on Expeditions," with the object of ultimately bringing the subject before the Government.

MISCELLANEOUS.

Twenty-third Meeting of the British Association for the Advancement of Science, held at Hull, September 7 *to* 14, 1853.

(*Section E, Geography and Ethnology.*)

President.—Dr. ROBT. GORDON LATHAM, M.A., F.R.S., F.R.G.S.

Vice-Presidents.—Capt. Sir J. C. Ross, R.N., F.R.S.; Rt. Hon. Lord LONDESBOROUGH, F.R.S., F.R.G.S.; JOHN CONOLLY, M.D.; Col. CHESNEY, R.A., F.R.S., F.R.G.S.

Secretaries.—Dr. NORTON SHAW; R. CULL, Esq.; and the Rev. H. W. KEMP, B.A., of Hull.

Committee.—Sir Benjamin Outram, C.B., F.R.S., F.R.G.S.; Sir Ch. Anderson, Bart.; Rev. Wm. Arthur, M.A.; Wm. Spence, F.R.S.; Wm. Camps, M.D.; A. G. Findlay, F.R.G.S.; John Lee, LL.D., F.R.S., F.R.G.S.; Fr. Hindmarsh, F.R.G.S.; John Hogg, M.A., F.R.S., F.R.G.S.; F. Tuckett, F.R.G.S.; H. M. Chadwick, F.R.G.S.; J. Ashley Warre, F.R.G.S.; Bethel Jacobs, Esq., of Hull; Dr. Buist, of Bombay, F.R.G.S.; Judge Kennedy; Th. Wright, M.A., F.S.A.; Anthony St. Leger, F.R.G.S.; Clements Good, Esq., of Hull; Col. Sabine, R.A., F.R.S., F.R.G.S.; Dr. Hamel; and the Rev. Dr. Scoresby, F.R.S.

The Papers read were—

1. Iceland, its Inhabitants and Language, by John Hogg, Esq., F.R.G.S.
2. The production of Gold in the British Isles, by Mr. Calvert.
3. On the Currents of the Atlantic and Pacific Oceans, by A. G. Findlay, F.R.G.S.
4. Manners and Customs of the Jacontes, by Prince Emanuel Galitzin, Corr. F.R.G.S., translated by Dr. Shaw.
5. An Inquiry into the Variations of Climate within the Tropics, especially with reference to the climate of the Gulf of Carpentaria, by Trelawney Saunders, F.R.G.S.
6. Ethnological Remarks upon some of the more remarkable varieties of Mankind, represented by individuals now in London (Zulus, Earthmen, Australians, Aztecs).
7. Ascent of the River Koladyn, in Aracan, by Capt. S. R. Tickell, communicated by the Royal Geographical Society.
8. On the popular Theory of an Arctic Basin, by the Rev. Dr. Scoresby, D.D., F.R.S.
9. Contributions to the Ancient Geography of the Arctic Regions, by Prof. Ch. Rafn of Copenhagen, Corr. F.R.G.S., communicated by Dr. Shaw.
10. Influence of the Invasions of the Scandinavians on certain localities in Britain, by Sir Ch. Anderson, Bart.
11. The Dialects North and South of the Humber compared, by Ch. Beckett, Esq., of Hull, M.R.C.S.
12. Traces of a bi-lingual Town (Danish and Anglo-Saxon) in England, by Dr. R. G. Latham.
13. Extract from Notes on a Journey to the Balkan, or Hæmus, by Lieut.-Gen. Jochmus, communicated through Sir Rod. I. Murchison.
14. Progress of Discovery in the Western Portion of New Guinea, from 1828 to 1852, by G. W. Earl, Esq.
15. The supposed Tombs of Ezekiel, and the Country to the West of the Euphrates, by Th. Kerr Lynch, Esq., communicated by Col. Rawlinson, through the Royal Geographical Society.
16. Proposed Expedition in Northern Australia, under Mr. Ernest Haug, as advocated by the Royal Geographical Society.
17. Notes on the probable condition of the interior of Australia, collected by A. Petermann, F.R.G.S.

18. On certain Places in the Pacific in connection with Great-Circle-Sailing, by the Rev. C. G. Nicolay, F.R.G.S.

19. Second Journey to St. Lucia Bay and the adjacent Country in S.E. Africa, by Mr. R. W. Plante, communicated by Dr. Shaw.

20. On certain localities, not in Sweden, occupied by Swedish populations; and on certain Ethnological questions connected with the Coasts of Livonia, Esthonia, Courland, and Gothland, by Dr. R. G. Latham.

21. The Brigantes, Romans, and Saxons on the Yorkshire Wolds, by the Rev. T. Rankin.

22. A proposed New Route between the Atlantic and Pacific, *viâ* the River Maulé in Chili, by Capt. Walter Hall, communicated by Dr. Shaw.

Among the recommendations adopted by the General Committee of the Hull Meeting, may be mentioned as connected with geography, "That the Committee for providing a large Outline Map of the World, consisting of Sir Rod. I. Murchison, the Bishop of St. Asaph, and the Secretaries of the Royal Geographical and Ethnological Societies, be reappointed, with the addition of Sir James Ross and Dr. Latham, with 15*l.* at their disposal for the purpose.

"That the three following papers be printed in full in the Transactions of the British Association for 1853:—Some of the Physical Features of the Humber; and The Rise, Progress, and Present Position of Steam Navigation in Hull, by James Oldham, Esq.;—also Observations on the Character and Measurements of Degradation of the Yorkshire Coast, by Dr. J. P. Bell.

"That the Members of the British Association have learned with satisfaction the intention of Government to direct, in future, daily meteorological observations to be made at sea, in correspondence with the plan adopted by the Government of the United States, on the suggestion of Lieut. Maury, and to take such further steps, in reference to the mercantile marine of Great Britain, as may be best suited to stimulate and encourage the masters of British merchant ships to take interest in investigations by which the times of passage between different parts have already, in many instances, been materially shortened, and which may lead to other results of the greatest importance to practical navigation.

"The British Association entirely concurs in the opinion that to make the observations, thus contemplated, serviceable to the purposes for which they are designed, it will be necessary to make provision for their co-ordination, and for deriving from them the instruction which they may be capable of yielding, for the advantage of Navigation, and for the benefit of Science."

The next meeting of the British Association will be held at Liverpool.

PRESENTATION

OF THE

GOLD MEDALS

AWARDED TO Mr. FRANCIS GALTON AND COMMANDER E. A. INGLEFIELD, R.N.

The Founders' Medal has been awarded to Mr. Francis Galton, "for having, at his own cost and in furtherance of the expressed desire of this Society, fitted out an expedition to explore the interior of Southern Africa, and for having so successfully conducted it through the country of the Namaqua, the Damara, and the Ovampo (a journey of upwards of 2000 miles), as to enable the Royal Geographical Society to publish a valuable memoir and map in the last volume of the Journal, relating to a country hitherto unknown; the astronomical observations determining the latitude and longitude of places having been accurately made by himself."

Whilst the above paragraph conveys the reasons which induced the Council to make this award, it is gratifying to me to add to it a few words of commendation.* I will not now repeat what I expressed last year, in giving a sketch of Mr. Galton's adventurous journey across that portion of Africa into which he was the first to penetrate. Those comments, which are now published in your Journal, concluded with a reference to certain astronomical observations, whereby the latitude and longitude of many places were determined, and which would, when published, be found, I hoped, worthy of your approbation. These observations having been examined by a committee of our associates, and having been entirely approved, the Council saw in this fact, a special reason why the journey of Mr. Galton should be preferred to all other enterprises now on foot in the interior of Africa; none of which had, as far as we were aware, determined such positions in other tracts of that continent.

Standing alone, therefore, in this respect Mr. Galton had a distinct claim on us above all his African fellow-travellers; and when we add to this consideration, that he had fitted out the expedition at his own expense, in furtherance of our wishes, and had successfully accomplished a most adventurous mission, we willingly offered to him one of our medals to mark our sense of the positive value of researches thus made by an independent English gentleman.

The President then rising, addressed Mr. Galton.—"It is now my pleasing duty to present this tribute of the Royal Geographical Society

* Mr. Galton's animated description of the Damara and Ovampo people, among whom he travelled, and the graphic sketches of his adventures, which have justly procured him the approbation of many readers, have been published since this Address was delivered.

to you, who quitted a happy home, and, in the ardour of research, explored at your own cost and under great privations a region probably never before trod by civilized beings. So long as Britain produces travellers of such spirit, resolution, conduct and accomplishments as you possess, we may be assured that she will lead the way in advancing the bounds of geographical knowledge. Pray receive this Medal as the testimony of the sincere approbation of the Council and Members of the Royal Geographical Society."

Mr. Galton replied :—

"Sir,—In acknowledging your very flattering expressions, and the kind sympathy which this Society has more than once shown towards me, I accept its Medal with the deepest gratitude. I am by it assured that the peculiar difficulties I experienced in travelling through a most inhospitable country are recognised, since you thus highly reward the efforts I made. Mr. Andersson, who was my companion, still remains in Africa, and he will, I trust, extend the limit of our joint explorations."

The President then proceeded to explain the grounds on which the other Medal had been adjudicated. "The Victoria, or Patron's Medal, has been (said he) awarded to Commander E. A. Inglefield, R.N., for his very remarkable and successful survey of the coasts of Baffin Bay, Smith Sound, and Jones Sound, in the last summer, during which he threw much new light on the geography of the Arctic regions, and with very limited private means accomplished most important results."

At our last anniversary, it was my painful duty to announce to you that the private expedition of the Isabel screw steamer, which had been prepared mainly through the liberal expenditure of Lady Franklin, and partly by the subscriptions of individuals, could not proceed, as was intended, to Behring Strait. But, even whilst the discourse delivered on that occasion was passing through the press, I had the gratification to announce, that the same stout little vessel having been given by her owners to Commander Inglefield, that gallant officer had undertaken, at his own risk, the enterprise of exploring Baffin Bay, including Jones and Smith Sounds.

This effort, undertaken so late in the season (for it was the 10th of July before the Isabel sailed), was indeed looked upon in scarcely any other light than that of an independent reconnaissance, in which everything was left to the energy and skill of the Commander, who might, it was hoped, turn so appropriate a vessel to some good service, by filling up lacunæ in Arctic discovery, even if he failed in the great object of obtaining any tidings of Franklin and his associates. When inspecting the preparations for the departure of the Isabel, I had strong reason to admire the energy with which Commander Inglefield equipped his vessel, and the ability and skill with which he overcame many difficulties. The survey which he made of the eastern and northern shores of Baffin Bay, in the few weeks at his disposal, is, I believe, the greatest amount of Arctic research ever accomplished in so short a time. It is true that good old Baffin, whose name is imperishably affixed to that great sea, around which he was the first to navi-

gate, defined the outlines of its chief bays and headlands; but much more was required to exhaust the survey, and to bring certain suggestions concerning the fate of Franklin to the test of critical examination, than had been realized by any of the followers of Baffin. First clearing away all doubts respecting the destruction of our missing navigators by the Esquimaux on the east side of the bay, and favoured by a singularly open season, Commander Inglefield surveyed all the headlands and inlets from the Danish settlements to the northward, and judging from the set of the current, as well as from the great length of an opening unnoticed by former explorers, he suggested that in the 77½° of north latitude, Greenland is probably separated from the more southern lands by a continuous strait, and is thus insulated.

Besides delineating the outlines of many masses of land which never before were named, he boldly sailed into the northernmost opening or Smith Sound, into which Baffin only peeped, but which he, Inglefield, so far penetrated, as to determine that a current there prevailed from south to north, thus indicating a communication between Baffin Bay and a great unknown Arctic sea. The determination of this point, which is of the highest importance in respect to all Arctic endeavours, was accompanied by the discovery of lands covered with a green vegetation, a conspicuous island in the distance, and an abundant distribution of animal life in a higher degree of latitude than was ever reached by any navigator in that meridian. Unluckily, a furious storm drove back the little Isabel, and carried her out of the strait far to the south, or assuredly the explorer would have forced on his way, and have endeavoured to reach that "Polynia" or open northern sea, which it is presumed that Belcher may have entered by another channel.

When defeated in that project, see with what skill and energy he employed his remaining days of fair weather. Entering Jones Sound on the west coast of Baffin Bay, he so far trended its banks, and ascertained its current, now an outward one, as to lead him to believe that this so-called "sound" might be also a *strait*, communicating with a northern sea; thus confirming the views arrived at by similar tests applied to the east and north sides of the great bay. And as the navigable season came rapidly to a close, mark with what good seamanship he got rapidly round through the fast-accumulating ice and shoals, with his little screw, to Beechey Island, and how he put himself in communication with the station of our Arctic squadron.

Let me here advert to one of the deeds of our medallist, for which, in my opinion, the friends of Franklin ought to be sincerely indebted to him. That three of the missing expedition had been buried in Beechey Island was well known, as recorded on their gravestones; but their graves had never been examined. Now, whatever prejudices sailors might have on such a subject, Commander Inglefield, being in a private expedition, resolved to dig down into the frozen ground, for the purpose of ascertaining the condition in which the men had been interred. The opening out of one coffin quite realized the object he had in view, for at six feet beneath the surface, a depth reached only with great difficulty, by penetrating frozen ground as hard as a

rock, a coffin, with the name of Wm. Heartwell, was found in as perfect order as if recently deposited in the churchyard of an English village. Every button and ornament had been neatly arranged, and what was most important, the body, perfectly preserved by the intense cold, exhibited no trace of scurvy, or other malignant disease, but was manifestly that of a person who had died of consumption, a malady to which it was further known that the deceased was prone. The knowledge of this simple fact assures us therefore, that when last at Beechey Island, the Franklin expedition was in perfect order, and ready to traverse the icy barriers the moment weather permitted.

Even in returning home, and in very tempestuous weather, we see how much Commander Inglefield added to our acquaintance with the west coast of Baffin Bay, and I must say, that when he re-appeared among us last autumn, the clear and manly description he gave of what he had done in the brief space of three months, accompanied as it was by charts and very numerous characteristic drawings, produced such an effect upon all geographers, that I felt certain the Council of our Society would crown so brilliant and successful a survey with its highest reward.

Sir Francis Beaufort having offered to receive the medal, the President thus addressed the gallant Admiral :—

"To you, Sir Francis, who are the best possible judge of the merits of an Arctic explorer who has delineated headlands, gulfs and straits, in a manner formerly unknown to us, I have singular satisfaction in handing this Victoria Medal; since your offer to receive it for your friend is the best guarantee we can have that our award is a just one. I feel, indeed, assured that when Commander Inglefield returns from the renewed Arctic Expedition on which he has just sailed, and learns that the veteran and distinguished hydrographer of Her Majesty's Navy has stood sponsor for him on this occasion, he will acknowledge that he has received an honour second only to that of the entire approbation of the Royal Geographical Society."

Admiral Sir Francis Beaufort replied :—

"Sir Roderick,—First thanking you for the gracious and flattering terms in which you have addressed yourself to me, I am desirous of expressing the double pleasure I have had in listening to the masterly panegyric you have bestowed on my gallant friend, and in being made the medium of transmitting to him this high and well-merited honour which has been unanimously awarded to him by our Council—which has been so heartily confirmed by the acclamations of the present numerous meeting of the Society—and which will be warmly ratified by the voice of the nation.

"Sir, the object of these honourable testimonials is not only to reward, but to stimulate; and therefore, in accepting the duty you have conferred on me, I beg permission to add, that strongly as you have sketched out Commander Inglefield's brilliant antecedents, I venture to pledge myself that they will be surpassed by his future conduct."*

* Whilst these pages were passing through the press, Commander Inglefield was elected a Fellow of the Royal Society.

ADDRESS

TO THE

ROYAL GEOGRAPHICAL SOCIETY OF LONDON;

Delivered at the Anniversary Meeting on the 23rd May, 1853,

BY SIR RODERICK IMPEY MURCHISON, G.C.St.S., D.C.L., M.A., F.R.S.,

MEMBER OF THE ACADEMIES OF ST. PETERSBURG, BERLIN, COPENHAGEN; AND CORR. INST. OF FRANCE, &c.,

PRESIDENT.

OBITUARY.

IN opening this anniversary discourse, as is usual, with a record of the members we have lost, I first call your attention to the character and labours of that eminent geographer and geologist, my valued friend Leopold von Buch, so unexpectedly taken from us by a typhus fever. For although he had attained the age of 79, M. von Buch was still vigorous in body, and even during the last summer had climbed Alpine heights.

Many of you may recollect with what devotion I spoke of the attainments and qualities of our deceased foreign member, when, in the year 1845, I requested him to receive for his friend and countryman Carl Ritter, the medal which we had adjudicated to that distinguished Prussian geographer. I then expressed the joy I felt, when, as your President, I was enabled to consign to the great geologist of the continent, the medal which the geographers of Britain had adjudicated to their learned foreign contemporary. I dwelt with fervour on researches, geographical as well as geological, by which Von Buch had shed light on many lands, from the remotest parts of Scandinavia to the southernmost corners of Europe—from the Alps to the Canary islands. Alas! this bright spirit has fled, and I am now called upon to place before you some of the leading features of the man.

Born of a noble family, he was educated at Freiberg under Werner, and was the college companion of the illustrious Alexander von Humboldt, his warm friend throughout a long life. Well prepared by a sound education, he began his career early as a geographical traveller; a term as truly applicable to him as to Pallas, de Saussure, and Humboldt. In perusing the works of these great men, the reader at once finds himself in company with master minds, rich in every sort of knowledge of the earth, its subsoil, its products, or its atmosphere. In short, they each of them combine the acquirements of the geographer with those of the geologist, mineralogist, botanist, and naturalist. By organizing in recent times a division of labour among men of science, so as effectually to advance its separate branches, we have, it is true, gained some important steps; but we are painfully reminded, by the loss of Leopold von Buch, that we are now left almost alone with Humboldt, as the last representative of that race of philosophical generalizers, capable of placing before us in one work all the natural features and contents of a region.

Looking to one of the earliest of Von Buch's works, published fifty-one years ago, and reading his racy descriptions of the forms and heights of the mountains, the quality of the soil and subsoil of various parts of Germany and the Alps; his graphic sketches of the extinct volcanoes of Central France, and of the active operations of Vesuvius, accompanied as they are by the first clear general view of the subsoil of ancient Rome, field-geologists like myself cannot but offer him a sort of hero-worship.

If we pass to another of his early productions—Travels in Norway* —see how pregnant it is with original thoughts on terrestrial physics. It was in this work, for example, that the oscillation of the land of Scandinavia was first pointed out as an actual geographical phenomenon, which explained former geological changes of sea and land. Celsius had, indeed, in the seventeenth century, noticed what he considered to be the retirement or depression of the sea. Linnæus subsequently caused observations to be made respecting it, and Playfair, whilst illustrating the theory of Hutton, had sagaciously suggested, what in the hands of Lyell and modern geologists has become admitted, that the land had risen whilst the sea was stationary. But Leopold von Buch first applied this view after personal observation

* The French edition has a preface by his fellow student at Freiberg, and his valued friend through life, Baron A. von Humboldt, who honoured me with a most touching letter on the death of his associate.—See 'Athenæum' and 'Literary Gazette,' March 12, 1853.

The English edition of 'Travels in Norway' is very scarce.

to a wide northern area, and all that we have since added to that which he then wrote, has been to estimate the amount of rise, and to show that whilst to the north of a certain line the land is undergoing elevation, to the south it is subsiding.

In exploring various parts of the Alps with M. von Buch, I never failed to obtain from him a clear insight into certain great phenomena respecting that chain, which to other men were obscure. Such was the manner in which he explained how the secondary and younger strata had been arranged around large ellipsoidal masses of granite and other eruptive rocks, and the consequent metamorphism of the surrounding strata. Such his definition of certain horizons or zones, which he determined through the aid of their typical fossils. Such his grand generalization respecting the spread of the nummulitic, cretaceous, oolitic, and other formations over various parts of the world.

And here let me say, in reference to the field labours of the geographer, that no explorer of the internal structure of mountains was ever a more perspicuous expounder of their physical forms.

Von Buch's large work on the Canaries, and the magnificent atlas which accompanies it, including his unique map of Teneriffe, all drawn with his own hand, offer results which no geographer could have accomplished, who was not at the same time a good geologist and thoroughly master of the whole subject of volcanic action. On this point my lamented friend entertained a conviction in which I fully participate, that, to give a proper feeling to his subject, the field topographer only knows half his business if he be not acquainted with the nature of the rocks he surveys. If ignorant of their structure, he may truly be compared to the artist who ventures to paint a great historic picture without an acquaintance with the anatomy and skeleton of the human form.

As therefore it is impossible to separate the sciences of geography and geology, I must say a few words on the methods by which M. von Buch attained his knowledge of rocky regions. Many of you know, that it is only by interrogating Nature amidst her most broken outlines, that the real secrets of the internal workings of the earth are to be ascertained. It is by extrusion from within that some of the innermost masses of the crust have been forced to the tops of the hills, and hence it was, that despising the muleteer and horseman, and placing his whole reliance on his own strongly knit frame, Leopold von Buch explored on foot, from its base to its summit, every mountain with which he desired to be acquainted. I have, indeed, accompanied him through Alpine passes, even when he had passed his 75th year, and when exposed to every inclemency of

weather, his only wardrobe consisted of a pair of stockings and a shirt, though in his side pocket he invariably carried the best detailed map of the country, a hammer and compass, and a memorandum book, in which he registered, at rare intervals, a few pithy words in the minutest hand, with graphic sections of the subsoil we had traversed. Carrying thus his baggage on his back (often including fossils which far outweighed all the rest of his equipage), he would march day after day, never tiring nor complaining, but always cheerful, though often fasting from the earliest dawn to nightfall, when he reached some humble habitation, there to take the chance of his only meal.

Again let me advert to one of the marked characteristics of the man, and say that he possessed a most unrivalled facility in turning his mind to any branch of natural history, by which he saw that his favourite science could be best advanced. Thus, he had almost reached 60 years of age, as a geographer, geologist, and mineralogist, when, perceiving that the real history of the successive ages of the crust of the earth could never be ascertained without a searching analysis of its imbedded organic remains, he went, as it were, to school in zoology; only, however, to become in a very few years a master in palæontology, or the history of fossil animals. As soon as he had in his possession this master-key of modern geology he succeeded in some of the happiest generalizations. Seated in his well-ordered room at Berlin, and surrounded by choice fossils, sent to him from distant regions, M. von Buch passed the winter months of many of the last years of his life in determining the range of European sedimentary formations through those quarters of the globe, which he had not been able to explore in person.

Hence it was that, without crossing the Niemen, he convinced himself, before I visited Russia with my associate De Verneuil, that the Silurian and older formations, as described in Britain, would be found in that empire and the Ural Mountains. Thus was it when he aided me in generalizing certain views respecting the wide diffusion of the Nummulitic formation of the Alps and Western Europe into the heart of Asia and Hindostan; and thus his very last work on the spread of the Jurassic rocks over different parts of the world, which he had just printed before he was taken from us, is a masterpiece of broad, general views, as essentially geographical as they are geological.

M. von Buch had one peculiarity to which I must here advert; for whilst this feature was part of his noble nature, and highly creditable to him as a man, it prevented his merits being half as widely known as they

deserve. He constantly published maps and memoirs at considerable cost, without his name; very often indeed not allowing them to be advertised. Hence one of the first duties of his admiring countrymen must be the concentration of all those scattered rays of light.

I must, however, restrain myself in my endeavours to illustrate even the salient points of the scientific character of such a personage, or I might fill a volume. I will, therefore, only now further allude to his benevolence, and that true charity which allows not the left hand to know what the right hand doeth; and on this point, I have no doubt that his biographer will relate abundant anecdotes of his generosity, and particularly of his kind encouragement of young and deserving cultivators of natural knowledge. Suffice it to say that, as during my own life I have never known a more true-hearted man, nor one more distinguished in those pursuits to which I am attached, so do I now sincerely mourn the loss of this illustrious geologist and geographer.

Leopold von Buch was a Member of the Institute of France, and an Honorary Member of the Royal Society of London, and indeed of nearly all the Academies of various countries. His value was duly estimated by his enlightened Sovereign, who not only named him one of his Chamberlains, but also conferred on him the Orders of the Red Eagle and of Merit.*

His Excellency Vice-Admiral Christian Christopher Zahrtmann, another of our Honorary Members, died suddenly on the evening of the 15th of last April, in the 60th year of his age, though apparently hale and vigorous. He was one of the ablest and most accomplished officers in the Danish navy, and being of a sincere and stedfast character, was deservedly held in the highest esteem. He was a Knight Grand Cross of the Royal Danish order of Dannebrog and Dannebrogsman, and of the Russian order of St. Anne; Knight of the French order '*Pour le Mérite Militaire;*' of the Prussian order of the Red Eagle, and of the Greek order of Our Saviour. He was also Master-General of the Naval Ordnance, Director of the Chart Depôt, Inspector of the Chronometer Bureau at Copenhagen, and a Chamberlain of his Sovereign.

Entering the Naval service as a cadet in 1805, Zahrtmann served as a lieutenant in many arduous and perilous services during the remaining years of the old war. At the general peace he betook himself entirely to geodesical and hydrographic labours, and was employed in the construction of an arc of the meridian, which was then being measured by

* The posthumous honours paid to Leopold von Buch on his interment at Berlin, together with an eulogium by Professor Cotta, have been recorded in a Memoir published at Berlin since this Address was read.

Professor Schumacher. After a cruise to the West Indies, during which he made a chart of a portion of those seas, and set up an observatory at St. Thomas, he was appointed successor to Admiral Lövernörn as director of the Hydrographic Office. In this capacity, notwithstanding much prejudice respecting the publication of documents, he brought the labours of his department to the highest degree of finish and exactness. The works, so important to the navigators of all nations, on which his fame rests, are the charts of the coasts of Denmark, with accurate soundings between the numerous islands, accompanied by determinations of the currents and trigonometrical surveys of the coast. His chart of the North Sea (1843) was indeed the greatest boon to all seamen, and to those of Britain in particular; whilst the Danske Lods, 'Danish Pilot,' which is a complete description of all the seas surrounding Denmark, has been found so useful as to have been translated, under the direction of Admiral Sir F. Beaufort, both into English and French.*

The funeral of Zahrtmann, which took place on the 24th ult., was attended by His Royal Highness the Hereditary Prince of Denmark and the other Royal Princes; also by all the ministers and the corps diplomatique, and a large number of naval and military officers and civilians. Some eulogistic stanzas upon the deceased admiral have been circulated, evidently written by one who knew him well; and as they are signed "S. B.," the author, we may conclude, is the worthy and scientific Rear-Admiral Steen Bille, minister of marine, who so ably commanded the 'Galathea' corvette on her late voyage round the world.

Among the deaths of foreign geographers I also regret to record that of General Don Joaquim Acosta, one of our corresponding members, who has done good service to his country and to our science. He is known particularly from his map of New Granada, in which the positions of more than 1000 places are fixed which were not given in any former map. He is also the author of an historical account of the Discovery and Colonization of New Granada in the 16th century, and of various valuable papers in the 'Seminario de Bogotá,' reprinted at Paris, containing some interesting information on the geography of the *ci-devant* viceroyalty of New Granada. After passing some time in Europe, including a visit to this country, he had returned to his own country, to undertake a survey of the snowy and almost unknown mountain group of St. Martha, and has bequeathed to the state of New

* A portion of the 2nd edition, lately published by the Hydrographic Office, was translated by Dr. Shaw.

Granada a vast mass of valuable documents, which there seems every desire to make available for the instruction of his countrymen. In this way the name of General Acosta may be rendered as memorable in our day as that of his famous namesake in the 16th century, the Father Joseph Acosta who gave to the world the first graphic sketch of South America in his 'Natural and Moral History of the Indies.'*

At the head of the deceased British Geographers of the past year, unquestionably stands Major-General Colby. Born in 1784, and son of Major Colby, of the Royal Marines, he passed through the Academy at Woolwich, was appointed to the Royal Engineers in 1801, and in the following year was attached to the trigonometrical survey at the special request of Capt. Mudge its director, who selected him on account of his superior mathematical qualifications. In 1803, when on a tour of inspection in Cornwall, the accidental bursting of a pistol so shattered one hand, that amputation of it was necessary, whilst a portion of the barrel fractured his forehead. But this misfortune had no permanent influence on his future career; for with the remaining hand he became a remarkably accurate observer and manipulator. He successfully served as Lieutenant, Captain, Major, Lieut.-Colonel, and Colonel to 1847, during a period of forty-five years, only then quitting the survey—unfortunately for the public interests—on having attained the rank of Major-General. He died at Liverpool, on the 9th of October last, leaving a widow and seven children to deplore their loss; lamented also by a large circle of friends to whom he was endeared by his ability, zeal, and singleness of heart.

The earlier years of Colby were, of course, passed in carrying out the views of Generals Roy and Mudge, in doing which, he singularly distinguished himself in his surveys of the Highlands. Being appointed Superintendent, on the death of Mudge in 1820, he continued the construction and engraving of the Ordnance maps of England and Wales, on the scale of one inch to a mile, or $\frac{1}{63360}$. But in 1824, the House of Commons recommended a survey of Ireland in more copious detail, so as to form the basis of a valuation of the country, and of a revised system of local taxation and townland registration. The Duke of Wellington, then Master-General of the Ordnance, at once confided the execution of this great mensuration to Colby; thereby affording him a crucial opportunity for displaying that union of energy, resource and judgment, which characterised him. Indeed, the

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* This admirable work of old Father Acosta, of which there is a very rare English edition, 1604, will I hope soon be printed by the Hakluyt Society, under the editorship of Lord Ellesmere.

Irish Survey was completely successful in its object, and may be justly deemed the great work of his life. A large portion of the force of the Ordnance surveyors had been then transferred to Ireland; but still the great difficulty at the outset consisted in the want of an adequate number of trained assistants. This Colby remedied by the employment of non-commissioned officers, privates, and even of native peasants, at one period amounting to 2000 in number. In all this his self-reliance was conspicuous, though ably supported by those energetic and skilful officers, the younger Mudge, Robe, Drummond, Portlock, Larcom, Yollond, Murphy, James, and others. By these means the survey advanced with unprecedented celerity, and the details were not only such as were required, but were also found to answer the wants of the geologist, statist and archæologist. The field-work was rapidly followed by the publication of sheets, on the scale of six inches to a mile, $=\frac{1}{10560}$; and the diligence of execution may be estimated by the fact, that, between 1833 and 1847, the number of such sheets issued to the public amounted to 1939. For the advances and improvements which were successfully introduced into geodesical operations during this great undertaking, I must refer my hearers to the account of the Ordnance Survey of the County of Londonderry, 1837; Colonel Portlock's Report of the Geology of Londonderry and parts of Tyrone and Fermanagh, 1843; the account of the Measurement of the Loch Foyle Base, published by order of the Board of Ordnance, in 1847; and Captain Yollond's recent volume of observations made with the Zenith Sector. I have before expressed my own opinion that although the publication of this six-inch survey was statistically useful in Ireland, it is a scale to which geographers cannot refer for general purposes, and is not in reality what we call a map; but to any objections of this sort Colby and his associates are in no degree amenable, for they admirably performed their duty in giving to the Government the means of administration which were required of them, and thus laid the foundation for a future compendious map, which has been commenced.

Quite irrespective, however, of a future general map (for none has yet appeared), the Irish Survey had prominent merits. Among these may be mentioned its remarkable accuracy of operation, the linear results it afforded of terrestrial measurements on a rigorous comparison with those obtained from astronomical determinations, thus furnishing interesting conclusions respecting the important and delicate co-efficient for the compression of the earth; and even giving rise to the supposition of a change in the direction of gravity from differences in the density of

terrene components. Nor can we overlook Colby's novel and comprehensive method of arriving at a datum of altitude for the heights inserted in his survey sheets, by causing a complete series of tidal observations to be simultaneously made at twenty-two different stations round Ireland; from these, he not only derived the desired zero, but also made the operation contribute to improvements in the theory of the tides, by the extent and conformity of the plan.

Besides the system of contouring, which was introduced under his direction by Captain, now Major Larcom, General Colby was the originator of many new and useful instruments and contrivances in his department, which cannot be here mentioned, but for an account of which I refer to a memoir of his life, just printed by a friend and coadjutor. In that memoir, which also clearly traces the progress of the Ordnance Survey, Colonel Portlock merits our best thanks for describing the peculiar merits of a chief, whose modesty and dislike of anything approaching to ostentation prevented his doing literary justice to himself and his associates, in having triumphed in our hazy climate, and on the summits of our highest mountains, over many difficulties of observation. From that record, those not so well acquainted with him as myself, will gain a just appreciation, not only of his solid acquirements, but also of the indomitable zeal of the man who did so much and said so little of his deeds. As geographers, we must admire the example he set (himself a worthy successor of General Roy) to all under his command, and the manner in which he inspired that school of eminent men whom he has bequeathed to us, with the true love of physical features, which made them forget all labour and distance, in following him for hundreds of miles on foot and over rugged precipices, to catch a fair glance with the telescope from some lofty summit. The graphic, short, diary of one of his subaltern officers, now Lieut.-Colonel Dawson, as given in this memoir, and describing a scientific march in the Highlands of 586 miles, brings out to the life the characteristic features of this pattern of a British Engineer.

At the time of his death, General Colby was a Fellow of the Royal Societies of London and Edinburgh, and of the Astronomical and Geological Societies; he was also a Member of the Institution of Civil Engineers of the Royal Irish Academy; and was one of our original Members. He also received the degree of LL.D. from the University of Aberdeen, and was a Knight of the Danish Order of Dannebrog.*

* From 1841 to 1846, both years inclusive.

Colonel Jackson, who died on the 16th of March, in the sixty-third year of his age, devoted many of the best years of his life to advance our science, and was for six years the methodical and diligent Secretary of this Society. In early life, he entered the military service of the East India Company, which he quitted at a period when our eastern possessions afforded much fewer incitements to young soldiers than the continent of Europe. At that time, when the world was resounding with the fame of Wellington, and the exploits of his Peninsular soldiers, our deceased member returning home, made an effort to obtain service in the British army, but the obstacles were insurmountable. Soon after, however, when England was visited by the allied Sovereigns (1814), he, in common with many young Englishmen who had no other military career open to them, offered his services to our ally, the Emperor Alexander of Russia, and they were accepted. In that service he rose to the rank of Colonel of the Staff Corps, and on his retirement from it, obtained, from the then Imperial Minister of Finance, Count de Cancrine, the scientific appointment of Correspondent and Commissioner in London for the Department of Manufactures, through the emoluments of which, and his income as our Secretary, he was enabled, for many years, creditably to support his wife and family. But shortly after he retired from his duties as our Secretary, another gentleman was most unexpectedly appointed to the post which he had long held, and thus he was suddenly reduced to distress, and compelled to retire from the Geographical Society.

Painfully aware of this fact, I no sooner mentioned it to the Marquis of Lansdowne, than seeing how well qualified Colonel Jackson was to fill an office in the Board of Education, that benevolent and gifted nobleman, then at the head of the department, named him to a clerkship, which he held to the day of his death.

Let me here, also, do justice to the Sovereign whom Colonel Jackson had formerly served. For when deprived of all means of subsistence save the employment of his pen, he wrote directly to the Emperor Nicholas, and His Imperial Majesty directed that a small pension should be settled on him. I have farther the satisfaction to state, that by the same Imperial kindness, the half of this annuity has, on a representation, been continued for the use of his widow. I indite these sentiments with the feeling of a soldier, old enough to recollect the good fellowship with which Russians and English served together, at the time when our late Secretary entered the Imperial army, and with the recollection that from the days of Peter the

Great, my countrymen have often proved some of the brightest ornaments in that service by land and by sea.

Colonel Jackson published many works which will be creditably remembered, and all indicating great industry, research, and precision of thought. His 'What to Observe,' which was first brought out in French in the year 1834, under the title of 'Aide Mémoire du Voyageur,'* is most useful in giving to the young traveller a true geographical foundation, both by pointing out his duties and by teaching him how to make observations, even when ill-provided with instruments, or when checked by physical difficulties; whilst it further incites him to acquire knowledge in every department of natural history, laws, customs, arts and sciences, including those military statistics which bear upon the country under survey. In this publication, as in every action of his life, Colonel Jackson worked out his data with that accuracy which was worthy of his military education, and of which he has left many proofs. Including contributions to periodicals, he was also the author of a vast number of memoirs and notices, chiefly relating to physical science and geography. Such, for example, were several contributions to the 'Bibliothèque Universelle de Genève,' in the years 1830 and 1831, on the Colours of Water, the Atmosphere, and Transparent Bodies, and on the Nature of Salt Lakes. Such also were his Observations on Lakes, and the Causes of their Formation and Diminution, published in London, 1833, and followed by an article in our Journal † on the 'Sieches' of Lakes. His other memoirs in our volumes are on Geographical Arrangement and Nomenclature; on the Congelation of the Neva; on Picturesque Descriptions; a translation of Weitz on Ground Ice; a review of Kupffer's Meteorological Observations; a review of Darwin's Coral Reefs: these were followed by an index to the ten first volumes of our Transactions,—all written with his own hand, and of which I find the record that it cost him the labour of 255 days, at five hours per diem!

He afterwards published a pamphlet on National Education, another in illustration of this Society and its labours; a glossary of geographical terms;‡ a work on Minerals and their uses; a memoir on Cartography; § an essay on the importance of Military Geography; ‖ and, lastly, the Military Topography of Europe, edited from the French of Lavallée, but which, in the hands of the deceased, became almost a new work.

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* This work, begun in 1822, was published at Paris. The 'What to Observe,' or the enlarged English edition of the same, was printed in London. Madden, 1841.

† Vol. iii. p. 171. ‡ Johnston, Edinb. 1848. § Parker, Strand.

‖ Parker and Co., Military Library, Whitehall.

In addition to these publications, and many contributions to societies in Paris and St. Petersburg, Colonel Jackson had, long before the retirement of our former excellent secretary, Captain Washington, shown himself to be thoroughly qualified to classify geographical labours, by suggestions concerning the arrangement of our maps and charts; and if ever the Government should be pleased to make the Royal Geographical Society what I have long urged, the real "Map-office of the nation," the system proposed by Colonel Jackson will, I think, materially contribute to the establishment of order and perspicuity in that which will, I trust, become a national establishment. In 1845 he was elected a Fellow of the Royal Society, and so continued to the year of his death. He was also a Member or Corresponding Member of various Foreign Scientific bodies, and a Knight of the second class of the Russian Order of St. Stanislaus.

The late George Dollond,—a Fellow of the Royal and Astronomical Societies, and one of our original Members,—was well known to many of those whom I am now addressing, both for his character as an honourable man, and for his reputation as an efficient mechanician. He was born in London, on the 25th of January, 1774, and was brought up by his maternal uncle, the eminent optician, Peter Dollond, whose name he afterwards assumed; his own name having been Huggins. From the year 1805 until his death, on the 13th of May, 1852, Mr. Dollond maintained his position with ability and punctuality, inasmuch that, in the course of his career, he was honoured with the personal friendship of many of the most illustrious philosophers of the age.

The various instruments constructed by Dollond for practice in geodesy, navigation, astronomy, and every branch of philosophical inquiry, were remarkable for accuracy of principle, skilful graduation, and excellent workmanship. Those made for the fixed observatories of Cambridge, Madras, and Travancore, as well as those for the private establishments of the Rev. Mr. Dawes, Captain W. H. Smyth,* Lord Wrottesley, and Mr. Bishop, all and severally did good work, and met with deserved approbation. But as it is unnecessary here to enumerate the many works by which he maintained the celebrity of his name, I will conclude by mentioning his last, the ATMOSPHERIC RECORDER, which, I have no doubt, most of you examined at the Great Exhibition of 1851. This was the epithet which he applied to a self-registering apparatus

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* My distinguished predecessor has become Rear-Admiral Smyth whilst these pages are going through the press. His great work on the Mediterranean will soon be issued to the public.

for simultaneously recording the varying pressure of the atmosphere, the changes of temperature and evaporation, electrical phenomena, fall of rain, and force and direction of the wind. For this very ingenious, and all but portable instrument, which registers all these changes during any period of time, according to the length of the paper used on the roller, Mr. Dollond obtained the reward of the Council Medal of that Exhibition; and this clever arrangement was the closing effort of his long and well-spent life.

Captain Granville Loch, who was killed in the endeavour to storm the fastness of a Burmese robber-chieftain, in the last campaign of the Irawaddy, in the 40th year of his age, was the second son of my old friend Mr. James Loch, during many former years and still the highly useful representative of the Northern Burghs in Parliament. Serving in early life in the Mediterranean, Atlantic, Pacific, Indian, and Baltic Seas, and in various ships, young Loch obtained his lieutenancy in 1833 and the rank of commander in 1837, or at the early age of 24. On coming home from the Mediterranean to receive that step, his youthful appearance so surprised the clerk in office, that he hesitated in issuing the warrant, saying "it was usual for the officer himself to come for the commission." After carrying out despatches for the Admiral in the Pacific, in the 'Fly' gun-brig, he rode across the Pampas from Buenos Ayres to Valparaiso; not, however, before he had failed in a first effort to do so, from being attacked and pursued back to Buenos Ayres by wild Indians. After other services, including the command of the 'Vesuvius' steam-frigate, he was made post-captain in 1840, and during the following year served as a volunteer in the Chinese War, an account of which he published, in an instructive and lively narrative, entitled 'Events in China.' Subsequently, after commanding the 'Alarm,' in the West Indies, he conducted, in 1846, an expedition up the river San Juan de Nicaragua, to repress the aggressions of the Nicaraguans on our ally the young King of the Mosquito Indians; and though the sailors and soldiers under his orders suffered excessive privation, from want of food and incessant rains whilst in open boats, he accomplished his mission successfully. Here it was that Captain Loch showed his geographical spirit; for, when lying in the Lake of Nicaragua, he made soundings of that sheet of water and its affluents, and prepared a chart exhibiting the general features of their navigation, which was sent by him to our Society.

For these last services Captain Loch was made a Companion of the Bath. In 1852 he was appointed to the 'Winchester,' 50, and proceeded to the East India station, and, as we all know, was one of the

most successful of our naval heroes in clearing the river Irawaddy, and in capturing the forts on its banks.

The same daring spirit, which was his characteristic, and had hitherto ensured success, led him unfortunately into the ambush, in which he received a mortal wound, after cheering on his men to force an impervious thicket; and thus, alas! were we deprived of a noble fellow in the flower of his age, and endowed with all the vigour, as well as the ability, to vindicate our country's honour in the day of need. Let me add that Captain Granville Loch was as much beloved for his agreeable manners and fine temper, as he was admired for his professional skill and gallantry.

The other Members of our body who have departed this life are:—Captain Wentworth Buller, R.N.; Mr. James Ewing; Captain Locke Lewis, R.E., F.R.S.; Mr. Alexander Mackenzie; Sir I. H. Pelly, Bart., Governor of the Hudson's Bay Company; Lord Skelmersdale; Sir F. B. Watson, F.R.S., and Mr. George Wilbraham, F.R.S.

Arctic Discovery and continued Search after Franklin.

At our last anniversary it was my duty to give you a sketch, however imperfect, of some of the chief features in Arctic discovery since the time when my honoured friend Franklin left our shores. Advocating in no stinted measure the employment of national resources for this humane end, I rejoiced in announcing the departure of the expedition under Belcher and Kellett; and before the discourse was printed, I had the gratification of also adverting to the sailing of the little 'Isabel' under Inglefield. The brilliant success which attended the latter enterprise has been already adverted to in awarding to its commander the Victoria medal; but of the progress of the great expedition we as yet know little more than the news brought home to us last year.

The speculations of geographers and seamen have indeed been again roused to consider the route which the absent mariners may have taken. In a recent article of the Quarterly Review an opinion which had been to a great extent set aside is renewed. It is there suggested that, in obeying his orders, Franklin must have sailed from Beechey Island to the west and by south, and not to the north and west through Wellington Channel. Fortunately, there are now so many expeditions afloat and acting in such different directions, that if the ultimate rescue of some at least of our countrymen should not be effected, we still may presume, that we shall at length positively ascertain the direction which was followed by Franklin after he left Beechey Island.

Unshaken by opposing arguments, I still believe that Franklin, finding himself unable to force his way to the west, seized just such an opportunity of thaw and dislocation of the ice as that by which Belcher profited last year, and steered either through the Wellington Strait or some other opening (possibly one of those straits indicated by Inglefield), in the hope of finding a northern and comparatively open polar sea. Every experiment which has been made has indicated, what few geographers indeed could doubt, that vast accumulations of ice exist along the northern shores of the great American continent and its adjacent numerous islands. The range of the lines of greatest cold dependent on the prevalence of land in those latitudes, necessarily leads us to this inference; and observation, as far as it goes, has confirmed it.

The exploration of Rae, which last year you honoured with your highest reward, went far to satisfy my mind, that no ship expedition ever could have approached to, or still less have trended, the real shores of North America and its islands. Again, the very remarkable land journey of the bold and enterprising navigator Kennedy and his spirited companion Lieutenant Bellot* of the French navy, of which we had a very interesting account at our first meeting of this session, established in a conclusive manner that, as the narrow strait, so worthily named after the French officer, was the only opening into the sea, between North Somerset and the Prince of Wales Land of Ommaney, so was it hopeless to search for the missing expedition in such latitudes. The work by Mr. Kennedy, since published, and which every one will peruse with profit, leaves, indeed, no doubt on this part of the subject. The renewed exertions of Rae, who is now again employed by the Hudson's Bay Company, to travel perchance a few more thousand miles in snow shoes, will still more effectively set this question at rest, and complete our acquaintance with the few remaining parts of the North American geography, of which we have not yet a correct knowledge.

Now, if the ice in these parallels be so agglomerated and packed along the edges of such great masses of land, by what agency is it to be removed? The Mackenzie and the Copper-Mine Rivers are but feeble streams when compared with the Ob, the Lena, the Jenessei—

* Lieut. Bellot, who with the permission of his Government rejoined our Arctic Survey, has just sailed with Capt. Inglefield, in the 'Phœnix,' for Beechey Island. It is to be hoped that this officer, who has won golden opinions among our seamen, for his courage, ability, and good conduct, may, on his return, be employed as a surveyor of the French Imperial Marine; for, as it is well known that the present Emperor of the French takes a lively interest in Arctic researches, we may hope that Lieut. Bellot will be promoted to the command of a French vessel in the same great cause of humanity, in which he has already so distinguished himself.

those grand Siberian rivers, which, with their enormous volumes of water rend asunder the vast quantities of ice which are packed along the north shores of Asia, and by their débâcle and currents transfer large portions of them to the coast of Greenland.

In the absence therefore of adequate causes of dislocation and transport (and the small effect of the North American rivers is already known), what reason have we to lead us to infer, that along the widely spread north-western shore of America, there are any practicable passages amidst its archipelago of large islands? Looking to Wellington Channel, as explored by Penny * and the bold American navigator De Haven, as well as to the supposed straits in Baffin Bay which are noted by Inglefield as having currents that proceed from a Polar Sea, are we not also informed that the distribution and great quantity of life indicates a vast and comparatively open sea to the north? Is this not indicated indeed by the positive observation of Parry's explorations to latitude 82°? Have we not, in the quantities of whales which come southwards under the ice through Wellington Channel, undeniable proof that there must be a vast proportion of smaller animals on which the huge mammalia feed? and if so, must there not be open seas towards the north pole? This natural-history testimony on the one hand, and the fact of an ice-bound American continent void of all self-extricating agency (like Siberia) on the other, seem to me almost decisive of this part of the question.

I have therefore little doubt, that were the father of all these expeditions, Sir John Barrow, now alive, and cognizant of what we know of the geography and products of these regions, he would himself counsel the experiment of steering through Wellington Channel, or some such strait, whereby the navigators could free themselves from the impenetrable ice which accompanies all extensive masses of Arctic lands. And if Franklin did so, why, I repeat,† may not the two ships which were seen floating southwards on an iceberg, have been the Erebus and Terror, which, when abandoned, had made a voyage around the eastern shores of Greenland without crews, rudders, or compasses?

But passing from this hypothesis, the opinion, which is entertained

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* The work of Dr. Sutherland, or the 'Journal of Capt. Penny's Voyage to Wellington Channel,' which has appeared since the last anniversary, is an admirable addition to the publications on Arctic researches, from its simple and clear style, and very graphic descriptions of many important subjects in natural history. As Dr. Sutherland is about to visit Port Natal, and this Society has furnished him with several costly instruments, we may anticipate much instruction from the observations of so good a naturalist in that very interesting tract of South Africa.

† See Address of last year.

by most p ns entitled to respect, is, that after all due attempts to execute h orders by steering westwards (a point, I admit, to which he would t sedulously attend), Franklin, not finding an exit in that direction, zed the first opportunity presented to him, and forced his way throug some one of the channels leading to the north. God grant that, by pu suing a similar course, Belcher may obtain tidings of the expedition, and that some of our absent mariners may still be in existence on an island surrounded by a polar sea, where their vessels being lost and the means of constructing boats denied them, they have ever since been prisoners! This is the brightest side of the picture which we can present to our mind's eye. For, if the expedition passed westwards into a region where it must soon have been bound up in ice at no great distance from the continent, why should we not have before now found some remnants of the crews, who in such case might have escaped to the northern shores of America, or have been heard of through the efforts of Richardson, Rae, and Kennedy, who have explored in that direction?

Whatever may be the fate of the courageous McClure, who pushed in boldly, as we know, to the north-east from Behring Strait, and however we must pray that this adventurous seaman may be met with by his excellent brother officer Kellett, to the west of Melville island, let us rejoice that the little 'Isabel' is at last, through the continued exertions of Lady Franklin (aided chiefly, as I shall presently explain, by the excellent inhabitants of Van Diemen's land), about to be sent in that direction which several members of this Society think is the right one, and to accomplish the very object, indeed, for which many of us subscribed.

Commanded by the fearless Kennedy, may this good vessel yet accomplish all that we desire! For, although our Admiralty has not thought fit to employ any vessel provided with a screw in the direction of Behring Strait, we ourselves feel assured, from all that Captain Kellett and the Russian navigators have told us, that by such appliances it is most likely that a vessel can twist and wend its way through tortuous, narrow lanes of water, and force itself through the countless packs and masses of ice, which encumber the Asiatic and American continents.

That a compact screw steam-vessel can best accomplish such navigation is indeed too manifest to be dwelt upon. The sailing-ship once ice-bound becomes an inert mass, which can alone be extricated by some great change of weather, or by labours almost superhuman; and once liberated from entanglement, her commander must often be but too anxious to avoid a similar catastrophe. The

screw-ship, on the other hand, if only short and strong, can be turned and conveyed through straits however narrow, and can penetrate through obstacles quite insurmountable by a sailing-vessel, and which, indeed, cannot be satisfactorily overcome by a steamer with side paddles.

The success attending the voyage of a small vessel under old Baffin, and the renewal of a like enterprize under Inglefield, lead me to direct your notice to a highly interesting, reprinted translation of the voyages of the early Dutch navigators, Barentz and De Veer, to Spitzbergen and Nova Zemla, which has lately been issued by the Hakluyt Society, and which does great credit to its editor Dr. Beke. We see in this work, how steadily the bold Dutch navigators adhered to the idea, that a real passage might be effected to the N. East, by holding a middle course between Spitzbergen and Nova Zemla, as recently revived by M. Petermann.* As an admirer of the prowess and indomitable courage of Barentz, I commend Dr. Beke for reinserting in the map attached to this work, the north-eastern portion of Nova Zemla, which has recently been omitted, and in giving to it the name of the old navigator; whilst with equal justice to the only other explorer of another portion of these frozen lands in our day, he has most appropriately assigned the name of our associate Admiral Lütke.

When we reflect upon the extraordinary discoveries made by the old Dutchmen in such small craft, the difficulties they overcame, and finally, how, after the loss of their ships, they constructed boats in which they worked their way home round headlands for 1700 miles, we may well think of what the small private expedition of the 'Isabel' may still accomplish! But whether it be by greater or smaller ships, and whatever be their equipment and armament, let us rejoice that our Government, seizing the spirit of our most enlightened countrymen, and despising the croakings of those who despond, should have favoured every effort, which to them seems most likely to obtain intelligence of our missing countrymen, by opening out our acquaintance with the inhospitable north. After the example of the rescue of the sailors of Archangel from their six years' captivity in Spitzbergen, to which I made ample allusion last year, geographers must never despair, until every legitimate effort shall have been made, of ascertaining the fate of our missing navigators.

In renewing my exhortation to exhaust the Survey, let me conclude

* M. Petermann prepared for the work a map of the Spitsbergen, or Barentz Sea, in which the outward course of the old navigator in 1594, and his return in two open boats round the north end of Nova Zemla, and by the coasts of Russia and Lapland, are detailed.

these allusions to Arctic discovery, by recording one of the episodes in its history, which redounds highly to the honour of the inhabitants of one of the most distant of our colonies. As a reward for his distinguished Polar services, Franklin was appointed to the government of Van Diemen's Land, where by his conduct he secured the affections and respect of all classes of its inhabitants. That this impression was indelible is now brought out by the fact that, after a lapse of many years, the Senate and other public bodies, as well as popular meetings, have united not only to send addresses to Lady Franklin expressive of their regard for her husband, and admiration of her devotion, but also to accompany them with a substantial sum of money to aid that noble-minded lady in the unparalleled efforts she has made and is still making. Of these addresses I specially cite that which proceeded from the Senate, and is printed at the foot of this page;* for the persons who could thus write and act are entitled to the warmest thanks of every philanthropist.

We cannot but indeed rejoice in such disinterested efforts of humanity, among which the spontaneous and costly endeavours of that truly noble citizen of the United States, our associate Mr. Grinnell, to which I alluded last year, stand conspicuous. It is with sincere

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* *To Lady Franklin.*

MADAM,—As the representatives of a country over which Sir John Franklin so long and so worthily presided, we cannot allow our present session to close without conveying to you a public expression of our sympathy for the peculiarly painful situation in which you have been placed with reference to the fate of your husband and his brave companions. Sir John Franklin will long live in the memory of this community, endeared by the many public and private virtues which pre-eminently distinguished him: and we who have had such opportunities of knowing his worth, must deplore, in no ordinary manner, the doubt which hangs over the fate of his enterprise.

We have witnessed with the deepest interest the exertions which have been made, and are still in progress, for the solution of this anxious problem. The noble part which you yourself have taken in maintaining and urging on those exertions is worthy of the character you earned while living amongst us.

While we thus offer you our most sincere condolence under the very distressing anxiety and suspense which you have had to endure, it is our earnest prayer to Almighty God, that through His good providence, the darkness which has so long covered your prospects may yet be dissipated by the restoration of your husband to his family and his country.

Signed in the name and by authority of the Legislative Council of Van Diemen's Land.

(Signed) RICHARD DAY,
Speaker.

Passed the Legislative Council this twenty-third day of September, one thousand eight hundred and fifty-two.

(Signed) F. HARTWELL HENSLOWE,
Clerk of the Council.

gratification that I hear of this benevolent gentleman having again renewed an expedition of search after the missing expedition.

Arctic Whale Fisheries.—Intimately connected as this great and important branch of British commerce is with the Arctic researches which we have been contemplating, it is gratifying to learn that so daring and experienced a navigator amongst the polar seas as Capt. Penny, whose name is so honourably distinguished in Arctic annals, should have been selected as the chief of an expedition which is destined, it is hoped, to realize wealth around the shores of Baffin Bay.

Our attention was, indeed, called to this important subject at the first of our meetings of the last session, and elicited much interesting discussion. In one of the memoirs which were read, Mr. Petermann reinforced the views he had previously expressed of the feasibility of a passage direct from Britain, through the only great opening towards the North Pole, or the Spitzbergen sea, by many well-registered facts. The extraordinary success which has attended the exertions of the whale-fishers of the United States, to which Capt. W. Baillie Hamilton called my attention last summer, has naturally roused the energies of many persons in this country, in the hope that the whales which have repaired to the farthest Arctic seas to live there undisturbed may yet be reached by the harpoons of our sailors.

A document communicated to the United States Senate by the Secretary of the Navy, on the 5th of April, 1852, explains clearly the very extraordinary and successful efforts which were only commenced in the year 1848, by the whale-ship 'Superior,' commanded by Capt. Roys, penetrating through Behring Strait into the Arctic Ocean. The success of this intrepid sailor who filled his vessel with oil in a few weeks, gave rise to many imitators, and, in 1849, he was followed by no less than 154 sail of American whale-ships; nearly the same number going out in each of the two succeeding years. When it is estimated that the value of the ships and cargoes during two of these years amounted to no less a sum than 17,412,453 dollars, we cannot be surprised that so lucrative a trade should excite much emulation among British speculators. As geographers, indeed, we must now be anxious to have this important question finally set at rest; *i. e.* whether (as I think, in common with old Barentz, Capt. W. B. Hamilton, and others) there may not exist a practicable passage to the Arctic Ocean to the east of Spitzbergen; in which case our ships might reach profitable whaling-grounds without the risk of a long voyage to Behring Strait, and the difficult navigation of those seas.

Let us still hope that our own Government will endeavour

to determine this point, so ably urged by Mr. Petermann, who has shown at how little cost, and in how short a time, the query could be answered, and who has also given many valid reasons to induce us to confide in the prospect of success. In the meantime we must offer our best thanks to the naval authorities of the United States, who, in consequence of the loss of many of their merchant-ships from the want of accurate charts, have directed a Survey to establish the position of the chief headlands and shoals around the Fox or Aleutian islands, and the regions contiguous to Behring Strait. And we cannot too cordially approve the following passage in the report of Mr. Graham, the Secretary of the United States Navy:—"No protection that our squadrons, or those of any of the States in Christendom, can at this moment give to our commerce, can compare with that which a good chart of that part of the ocean would afford to this nursery of American seamen, and to this branch of national industry."

Minerals, Glaciers, and Icebergs of Greenland.—Before we take leave of Arctic subjects, let me remind you that, judging from a memoir communicated by M. Lundt, of Denmark, and lately read to our Society by Sir Walter Trevelyan, on the mineral produce of the southern parts of Greenland, we have every reason to think, that valuable ores of copper may be found to extend far to the north of the tracts around Disco, where the minerals in question were observed. Judging from the few rocks submitted to my inspection by Capt. Inglefield, and which were collected in the more northern parallel of 77°, I should infer, from their crystalline character, that a very large portion of this region may prove to be metalliferous, and that industry may there be rewarded with spoils of the land, as well as by catching the whales and seals of the sea.

A memoir of very great merit, on the large continental ice of Greenland, and the origin of the icebergs of the Arctic sea, was sent to us last August (1852) by Dr. H. Rink, of Copenhagen, which is of deep interest to all physical geographers and geologists. Residing for several years in the Danish settlements on the west coast of Greenland, between the parallels of 68° and 74°, this author was the first to give to the public a good account of the mineral structure of the region north and south of Disco in a communication to the Royal Academy of Copenhagen. His memoir upon the ice of the same country, sent to this Society, is of great value in explaining several difficulties respecting superficial appearances, with which the geologist has had to contend. The polished, scratched, and grooved rocks which have been observed in various European countries, and in North America, have been by all

observers referred to some one of the following operations:—to the passage over them of solid or terrestrial glaciers,—to floating icebergs detached from such glaciers, and carrying with them many blocks and pebbles of stone,—to débâcles and currents, often set in motion by the melting* of great glacial masses on the edges of continents, and their translation in a liquid state through estuaries to other shores.

Although some persons may in their ardour have too exclusively advocated one of these methods in preference to the others, the majority of geologists have been willing to take advantage of all these agencies, and even to add another method to them, by supposing that blocks or gravel may have been transported by the breaking up and floating away of raft-ice, formed in fiords or along shores, or in shallow glacial seas.†

As doubtless large portions of our continents were under water when vast erratic blocks transported to great distances by icebergs and deposited on what are now plains of terra firma, so these must have proceeded from ice-clad continents. Among others, I have laboured with my associates to show how all the higher portions of Scandinavia and Lapland constituted a glacial centre in a former icy period, which sent off its stone-bearing ice vessels to what is now the dry land of Germany, then a sea-bottom. Dr. Rink now comes out with a demonstration, that in the present period, all the vast continent of Greenland, as far as is known, is one vast interior of ice, through which the rocks scarcely protrude, and though of no great altitude, is yet sufficiently high in its central parts to afford a slight

* Since this address was read, Commander Inglefield's volume on the voyage of the Isabel in Baffin Bay has been issued to the public; and in it Dr. Sutherland, the surgeon of the expedition, so creditably known by his description of Penny's explorations, has given us a sketch of the action of ice under various conditions, whether as proceeding from the great central plateau of ice in Greenland, or as acting when detached from the fiords and coasts. It is gratifying to see that this inquiring naturalist should, of his own accord, have come to the same conclusions as Dr. Rink. He has, indeed, added many remarkable data by observations made in much higher latitudes (up to 79½°) than those visited by the Danish author. Among these, the manner in which coast cliffs are striated by avalanches sliding over them, the irregular accumulation of drift-ice, and its change of place, seem to explain, by existing causes, some features of the most recent of our geological phenomena of drift, which it has been most difficult to understand. How much is it to be regretted that such a good observer has not been again sent out with Commander Inglefield! If left in Greenland to the north of the Danish settlements for two or three months, whilst the Phœnix was exploring northwards, he had been enabled to follow out a plan of which he has prepared a sketch, and which I shall soon make public, we might have had results in the ensuing autumn, which alone would have justified an expedition.

† See Russia in Europe and the Ural Mountains, pp. 507 *et seq.*; and a subsequent Memoir, Quart. Jour. Geol. Soc. Lon., 1846, pp. 249 *et seq.*

incline for the general and onward march of the enormous ice-field, until protruding its arms into deep and long lateral fiords, huge bergs are in certain favouring spots broken off from the parent mass, and *calve* (as the Danes term their launch), before they sail away into Davis Strait and southwards.

The glaciers which have been observed in the Alps, Norway, and Himalaya mountains, are separate ice streams, which fill valleys and radiate from certain lofty centres, carrying with them the materials out of which their moraines are formed. And in some of our insular extracts, such as Snowdon and the Cumbrian mountains, we can easily explain how such glaciers must there also have acted from similar centres, and have scratched and polished the shoulders of the valleys as they descended. But, as several authors have observed, and as Mr. Robert Chambers has well shown in a recent memoir,* replete with good new observations on the west coast of the Highlands, there are many lofty tracts in Scotland as well as in Norway and other countries, where the striation seems to be quite independent of the outline of the ground, thus indicating a grand and general movement of ice.

It is to countries which present such phenomena, that the memoir of Dr. Rink forcibly applies; and it leads us to imagine, that there was a period when Scotland, particularly all the Highlands, was analogous to what Greenland is now, and when an icy mantle extended itself from higher plateaux into the fiords or friths on its sides. In this case, doubtless, many of the rocks of the interior would be polished and striated, whilst those on the shores of the friths would also be similarly affected. In other words, the facts observed by Dr. Rink refer to a much vaster field of glacial phenomena than any previously known to naturalists. It is infinitely to be desired that geometers and geologists, like James Forbes and William Hopkins, will further exhaust this subject by explorations from the coast of Greenland into the interior, for the purpose of ascertaining the minimum inclination, on which the great mass advances and thrusts its icebergs into the sea; some of them formed in the centre of a vast continent, and hundreds of years before they are launched; and we have warmly to thank Dr. Rink for opening out an inquiry into the grandest feature of this subject, which has yet been brought under our consideration.†

* Edin. New Phil. Journal, April, 1853, p. 229.

† When this paper is printed in our volumes, the reader will find in it the distinction drawn between the formation of white ice and blue ice, which also illustrate on a very grand scale some of the phenomena so well described by Professor James Forbes in his work upon the glaciers of the Alps.

Russia.

The vast geodesical operation of the measurement of an arc of the meridian, between Fuglenaes on the north coast of Scandinavia and Ismail on the Danube, to which I last year adverted, has been completed; and we are now in possession of the historical exposé of the labours, by which this gigantic work has been brought about, as drawn up by its chief director, the astronomer Struve.* That eminent man has clearly and succinctly explained the part, which various official persons of the Imperial Russian Service have taken in this operation, particularly Lieut.-General Tenner, and he has faithfully recorded the great services rendered by the Swedish and Norwegian astronomers and mathematicians who, under the direction of the enlightened King of Sweden, extended the measurement to the northernmost headlands of Europe.

Up to this period Great Britain has had the merit of having accomplished the largest measurement of an arc—namely, that which was commenced by General Lambton. This measurement, passing through Hindostan, attained at length the colossal dimensions of 21° 21′ 17″, as explained by our distinguished associate Everest, who, executing a large portion of it, completed that magnificent work. This is still by far the longest arc, which has ever been executed without the interruption of sea, and on one continuous mass of terra firma, subject to the same government. But, embracing Scandinavia, the Baltic sea, and the provinces to the south of it, the Russian measurement exceeds that of India by nearly four degrees of latitude; its total length being 25° 20′!

It is pleasing to reflect that in the execution of this vast project, the science of Britain has aided that of Russia, Sweden, and Norway; the Indian standard having been confided by the Court of East India Directors to Mr. Struve,† to be compared with the Russian standard at Pulkova.

It is also to be remarked that in this operation the Swedish academicians wisely suggested, that in extending the measurement into Lapland it was highly desirable to take that opportunity of commencing a series of observations, which should give a definite future answer to that interesting question in terrestrial physics, of the amount of progressive

* 'Exposé Historique, par W. Struve, suivi de deux Rapports de M. Lindhagen sur l'Expédition de Finnmarken et les Opérations de Laponie.'—Acad. Imp. des Sciences. St. Petersburg. 1852.—The elaborate calculations of the Russian and Swedish mathematicians have yet to be made before the great work can be said to be completed, though the measurement has been finished as stated in the text.

† Colonel Everest used a 6-inch brass scale as well as an iron bar.

elevation of the northern parts of Sweden, by determining for a series of years the relative altitudes of the Glacial and Baltic seas.

As a member of the Imperial Academy of Sciences, although myself a cultivator of another branch of science, let me then say how much I rejoice, that the present ruler of Russia should have illustrated his reign by this the greatest of all the geographical works, which the combined powers of astronomers, surveyors, and mathematicians have yet accomplished—a work which never could have succeeded if, in his munificent encouragement of astronomy, His Imperial Majesty had not liberally endowed the Observatories of Pulkova and Dorpat, and placed at their head the philosopher who has in his own lifetime realized such a vast result.

The Geographical Society of St. Petersburg has been making good progress under the presidency of H. I. H. the Grand Duke Constantine; and we are duly acquainted with its proceedings* through its executive officers, General de Mouravief and M. de Milutine. One of the most important, in my estimation, of their recent labours is the publication of a map embodying the results of the survey of the sea of Aral by Commander-Captain Butakoff, of the Imperial Navy, and his assistant M. Pospéloff, as prepared by M. de Khanikof mentioned by me last year, and since illustrated by a memoir.

The gallant and intelligent chief of this survey has indeed communicated in a letter to me, which will soon appear in our Journal, an account of the labours undergone by himself and associates,—first, in conveying a ship built at Orenburg across the steppes, to be launched on the Sea of Aral. This was followed by the formation of a small arsenal, the construction of another ship, and finally by the complete survey of both shores, and the delineation for the first time of the islands in that sea, the largest of which is now named after the Emperor Nicholas. That this island had not been visited for generations (if ever) by human beings, is manifest from the relation of Captain Butakoff, who states that the antelopes were in no way scared by the sight of the Russians who came among them. Just as the guileless Mexicans beheld with astonishment, but without fear, the first Spaniards who landed on their shores as creatures of another world, so did these antelopes, the only inhabitants of the isle, approach and gaze at their first invaders.

* Having just received the bulletin of the Imperial Geographical Society of Russia, of April 30th, 1853, I am gratified to learn that their Constantine medal has been adjudicated to M. Kutorga, for his excellent new geological map of the government of St. Petersburg.

The light which had previously been thrown on the nature of this region was confined to a partial acquaintance with its rocks and botanical characters; and whilst our knowledge of these is greatly enlarged by the last survey, we have now for the first time obtained an accurate delineation of the outlines of this extraordinary region. There is perhaps no feature of more commanding interest, in its bearing on the physical outlines of the earth at a period which approaches near to our own æra, than the fact which geological researches* have established, that there has existed a vast interior sea which covered all the area between Constantinople on the west, and Turkestan on the east, or a length of nearly two thousand miles; whilst it ranged irregularly from S. to N. over a space broader than the present Caspian Sea is long, or of about one thousand miles. Of this great submerged area, the seas of Azof, the Caspian, and the Aral are now clearly the chief detached remnants. For, as I formerly explained, the very same species of mollusca which are now living in these seas, are found in a fossil state in limestones, forming cliffs on their shores or on those of the Black Sea, or in masses of intermediate land, which are simply the elevated bottoms of a once continuous vast internal sea, the whole of whose inhabitants were as distinct from those of the then ocean, as are the present inhabitants of these detached Caspians from those of the present Mediterranean and ocean.

Correct surveys, therefore, of the most distant parts of such a region are of the highest importance to the naturalist as well as to the geographer; and we have only to hope that the publication of the map of the Aral sea will be followed by an effort on the part of the Imperial Government, to complete the illustration of a subject so attractive to the historian, as well as to the geographer and geologist, by ascertaining through a correct survey, like that which established the depression of the Caspian, whether there be any existing difference between the level of that sea and of the Aral. The settlement of this question will enable us to determine, by what change of outline the Oxus was deflected from its course into the Caspian, and made to discharge its waters into the Aral, as suggested by Humboldt.

In connection with this subject, let me now call your attention to the new and important lights which have been thrown upon the south-eastern portion of that vast and little-explored region, in a volume recently published by our foreign associate, my friend, Colonel

* See Humboldt, 'Fragmens Asiatiques,' p. 10, et seq.; and 'Russia in Europe and the Ural Mountains,' vol. i. p. 297.

Helmersen, in an account of the journey of the late M. Alexander Lehmann to Bokhara and Samarkand in the years 1841–2.* Devoting himself at an early age to the study of natural history, and after several excursions in the north of Russia, M. Lehmann was appointed, in 1838, by General Perovsky, Governor of Orenburg, to investigate the natural history of that vast province. "Thus," says Colonel Helmersen, "in the course of nearly ten years he had become acquainted with a considerable portion of the Ural mountain and the Caspian plains, and was, by experience and practice, well prepared to accomplish with profit the great journey reported in this work, and which he was not destined to survive." In 1841, in company with M. Khanikof and Lieutenant Bogoslovsky, he explored, at the request of the Khan, the mountain district from Bokhara to the east, where large auriferous deposits were suspected to exist. Ascending the fertile valley of the Särafschan, they entered a district never yet scientifically explored, though cursorily visited by educated Europeans several centuries ago. They then beheld the once glorious and renowned Samarkand, with "its magnificent monuments of the age of Timur the Great; and penetrating the fine mountain district never yet described by Europeans, which is watered by the Upper Särafschan, they explored it as far as the river Fon." Thence they returned to Samarkand, and again reached Bokhara. Here they were detained the whole winter and part of the following year, during which time Lehmann employed himself in arranging his collection, and preparing a report of a portion of his journey. Among other sources of enjoyment he mentions his agreeable intercourse with our two lamented countrymen, Stoddart and Conolly, which was, however, finally interrupted by their imprisonment by the Khan. In hastening home, Lehmann fell a victim to a fever at Limburt, in the south of Russia, when he had, alas! barely completed his twenty-eighth year.

In his description of the journey to Bokhara, the geology as well as the botany of the country is described; though the latter science appears particularly to have occupied his attention. The hydrography too of the wild regions, after crossing the river Syr Daryà, was not neglected, and much good matter on this subject will be found in his pages; the result both of his own observations and of information obtained from the inhabitants. Respecting Samarkand itself and the manners of the inhabitants, and the antiquities still remaining, the book contains many

* Alexander Lehmann's 'Reise nach Buchara und Samarkand. Beitrage zur Kentniss des Russischen Reiches.'—St. Petersburg. 1852.

interesting notices. Besides its fortunate position as a central point for the then commerce of the world, the importance it acquired in the 14th and 15th centuries would appear to have been in a great measure owing to the luxuriance of the climate and the fertility of the soil, greatly increased by the extensive system of irrigation then applied throughout the whole district.* The third portion of the work contains notices on various subjects obtained during his residence in Bokhara, and from which we learn, that the variety of fruits is remarkable, and the nectarine indigenous; wine, brandy, and silk are among the products of the country. In addition, M. Lehmann adds some interesting details respecting the vegetation and the periods of ripening of fruit, which he obtained from the unfortunate Stoddart, by which it appears that the wheat harvest commences about the 1st of June.

Among the projects recently undertaken by the Imperial Geographical Society, let me add that there is one which must singularly interest every geographer and naturalist—a detailed survey of all the basin of Behring Strait, including Kamschatka, the north-west coast of America, and the Aleutian and Kurile Islands. In concentrating upon this grand object its chief attention and means, the Imperial Geographical Society may not only develope many new geological, volcanic, and zoological phenomena, but also give us a clear insight into the very remarkable tides of that region, which, according to Admiral Lütke, are alone worthy of an expedition.†

British Isles.—Ordnance Survey of Scotland.

Having at our last anniversary referred you to the various endeavours I made in former years, whether as your President, or as the representative of the British Association, to accelerate the progress of a survey of Scotland which began in the last century, I regret to say that the distinct recommendation of the Committee of the House of Commons in 1851, on which I so much counted, has been, from what I can learn, to a great extent paralyzed. That Report strongly recommended that the sum of 25,000*l.* per annum, which was obtained, and

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* Samarkand, the Marakanda of the Ancients, now lies about three versts to the south of the left bank of the Särafschan. In the town itself scarcely any remains of antiquity are to be seen. The river, however, has in the lapse of ages changed its course, and even the town seems to have undergone a similar change: in its immediate vicinity the travellers found numerous evidences of public buildings of great antiquity, with heaps of ruins—the clear evidence of the site of an ancient city.

† The United States government is also sending a surveying scientific squadron into those seas. (See p. cxviii.)

which has since been increased to 35,000*l.*, should be first exclusively devoted to the completion of a really useful map, on the scale of one inch to the mile. In consequence, however, of the petitions from various parts of Scotland, to which I alluded at the last anniversary, that view of the scheme, or the accelerated publication of a *real map*, must necessarily be very much retarded, to make way for the execution of *plans* on very large scales.

Few geographers who will take the trouble to read all the public documents connected with this subject, beginning with the appeal of the British Association to the Government in 1835,* and ending with the Report of 1851, including the Report of the same House of Parliament on the results of the six-inch survey of Ireland,† will, I apprehend, come to any other conclusion than that at which I arrived, or will not regret the indefinite postponement of the execution of an accessible and useful map. I now reiterate my conviction, which is that also of the eminent engineering authorities—Stephenson, Brunel, and Locke,—members of our body,—as well as of Mr. Keith Johnston, and all practical geographers, that a six-inch survey is much too cumbrous, and too little provided with physical features, to be useful for consultation on any matters of general or county business, and at the same time much too small for the detailed objects of the engineer, proprietor, or valuer of property. Such a six-inch survey was perhaps specially applicable to Ireland, where numerous disputes prevailed respecting the town-land boundaries in hilly districts; though many of the artificial lines and divisions of fields, laid down at much cost, have been changed, since the plates on which they are represented were engraved! No sooner, however, was this scheme completed, and in admirable style, at an expense of about 850,000*l.*, than the Irish proprietors complained through their representatives in the House of Commons, that their country was, *in reality*, *without a map*. And this statement, though made in the year 1847, is still perfectly true; for a six-inch survey is not a map which can be consulted, and Ireland, though long promised it, has yet no one-inch map.‡

Deeply respecting the opinions of our deceased member, General

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* Printed by order of the House of Commons. Trigonometrical Survey: Great Britain. 20th February, 1836. No. 106.

† See Report of Select Committee of House of Commons. Ordnance Irish Survey. 1846.

‡ I am assured by our Associate, the Marquis of Lansdowne, one of the most enlightened and improving landlords in Ireland, that finding the six-inch plans too cumbrous and unmanageable for general purposes, in reference even to his own estates, he found it necessary to have a reduced and compendious map executed from the large scale, *at his own expense!*

Colby, that accurate mathematician and most meritorious public servant, whose services I have this day eulogized, I would beg to explain the circumstances under which he undertook the execution of the six-inch survey. The British Trigonometrical Survey was in a very unsatisfactory state. The maps of large tracts of the South of England, which had been hastily sketched upon the scale of one inch to the mile by young military officers, required much revision. These sketches required, in fact, to be corrected, and are not to be compared with those most perfect and beautiful maps afterwards completed on the same scale, under his orders, which so perfectly delineate all the physical features of the country, particularly of the mountains of North Wales.

In that state of affairs a set of plans for general and local valuations of Ireland was demanded by the Government; and Colonel Colby saw, that as such documents were considered absolutely necessary, they might, if executed with precision, and under rigorous military control, form the sound basis of a future map. But, excellent as his survey was, it has not yet been followed by that general map which is demanded, though I hear that it has been commenced. I should, therefore, regret to see the same system persisted in for Scotland, where none of the political or social causes exist which rendered the large scale desirable in Ireland. In short, geographers and the Scottish public are put off with so remote a prospect of a general map, that the youngest man cannot hope to have one in his possession.

I re-assert that patriotism has, in this instance, been merged in the desire to obtain local advantages, and that the scheme of laying down on copper a six-inch survey is a waste of time, money, and labour, as respects immense tracts of moor and mountain in North Britain.

Let there, however, be no misapprehension in respect of the opinions entertained by many geographers, as well as myself, on the value of surveys on a large scale, and the application of contour lines. When formerly your President,* I spoke of the value of such contour lines as a most important auxiliary in completing detailed surveys; and I gave the fullest praise to Major Larcom, who was then so successfully working out their application in Ireland. But that which is very useful in certain undulating tracts, rich in minerals, and where it is important to ascertain the levels with precision, is of no value in flat boggy regions, and utterly useless in many wild, rocky, sterile, uninhabited tracts. On the other hand, it is in the latter regions that we specially require the skill of the good field-topographer to represent

* Journal of the Royal Geographical Society.

precipices, abrupt corries, ravines, pyramids and bosses of rock, which no contour lines can give.

But where are now the men to execute this task? The truth is, that the introduction of the Irish, or six-inch system, and its application to the North of England and Scotland, have too much diminished the strength of that body of able field-topographers. The men having a true eye for a country, and who executed the beautiful maps of North Wales and the adjacent parts of England, being no longer wanted, were to a great extent paid off, to make way for the mechanical admeasurements of the Royal Miners and Sappers, a meritorious but inferior class of men, whose labours have been directed by a few distinguished officers of the Royal Engineers.

I stated to the Committee of the House of Commons, and I repeat it, that I know of no topography in any country of Europe which excels, if it equals, in execution the Welsh sheets, which were prepared under the skilful direction of Colonel Colby and Major Robe. I only wish that the maps of the mountains of Snowdon and Cader Idris, on the one-inch scale, could be transmitted to the Highland proprietors, accompanied by any one of the great six-inch surveys, without physical features, which represent the bogs and mountains of Ireland, and ask them whether they wish to have these huge surveys executed (few rooms in Scotland being large enough for laying out the plans of one extensive county), and whether, at all events, in the first instance, they would not prefer to possess in their day a real map, which they could consult and understand?

The Scottish proprietors should recollect that the most important region of Britain, including more than two-thirds of England and all Wales, has only a map on the one-inch scale, and has never had a six-inch survey of it published. Nor am I aware that the inhabitants, except those of certain rich mining tracts, have ever asked for a larger survey.

I trust, at the same time, that we, who are eager to see a map of the whole country produced on the one-inch scale, may not be stigmatized as opposed to plans and surveys on any scale, however large, for administrative or statistical purposes.

Those most important objects come under a distinct head, as has been recently developed in a long and able letter addressed to the Hon. F. Charteris* by Lieut.-Colonel Dawson, R.E., and printed with other documents relating to this subject. Clearly indicating all the confusion of object, which has arisen among the clamourers for the six-inch

* Now Lord Elcho, M.P.

map (many of whom erroneously think they will have in it plans of their estates), this very competent authority has shown, that even during the execution of the six-inch surveys, the surveyors were at the same time called upon to prepare plans of parishes and townships in the North of England on the scale of $26\frac{3}{4}$ inches to the mile; and for sanitary purposes in towns on a scale of 60 inches or 5 feet, and even of 10 feet to the mile.

Whilst no one can doubt the value of documents of this large size, to which I called your attention last year, and admitting that there is every reason to wish for them as complete cadastral plans and measurements of the populous districts, particularly in those tracts in which mines abound, we must as geographers express our regret, if the execution of a real map of so interesting a portion of our country should be procrastinated by the limited sum of money granted for this purpose being so extensively applied to these affiliated subjects, however important.

No set of men can be more competent either to complete a map of Great Britain on the one-inch scale, as already executed for two-thirds of England, and as ordered to be executed for Ireland, or to make the largest plans required for towns and populous districts, than the officers of the Royal Map Office. My only wish, therefore, is that at least one great division of this corps should be so re-organized* as to be applied at once to *the field topography* of Scotland; for now that the triangulation is completed, there can be little doubt that by the employment of some able hill sketchers, the right application of the sum which was virtually granted to make a map would, in very few years, realize the main object of geographers.

Let the Parliament grant *additional* sums for the execution of large plans for sanitary purposes in the Scottish towns; let the survey on various scales, each proportioned to the wants of the places, be by all means proceeded with; and let the largest of these original field surveys be kept in an office where any persons beneficially interested might obtain, at a small cost, copies of the same; and let even 12-inch plans of certain tracts, where requisite, be engraved. But for the honour of our native land, let not Scotland continue for an indefinite period to be *the only country in Europe without a good general map.*

I have on former occasions pointed out the usefulness of the maps of various foreign countries, and I have to-day adverted with pleasure to the progress which a small state like Sardinia has made in this respect.

* Since this was read, I learn from my friend Captain James, R.E., Director of the Survey of Scotland, that a party has recently been organized for this purpose.

Possessed of a complete map of Piedmont and Savoy, the Government of that country, being urged by its Parliament in 1850, ordered the lithographic publication of this map on the scale of $\frac{1}{50000}$, and to be sold at the rate of two francs per sheet. In the execution of this desirable work (a great many sheets of which have already appeared), the ground is scrupulously re-examined; and the whole kingdom, though about the most difficult region in Europe, will be illustrated on this useful scale in six years. The contrast between this poor but spirited state and our own rich country is, indeed, truly striking!

Having commenced the agitation of this subject in 1834, when certain promontories of the Highlands were laid down some miles out of their true position on maritime charts, and when I further knew from personal examination that the topography of the interior was in a disgraceful state; and further, having induced the British Association to take a decisive step in this matter, before the Highland Society or any other public body moved in it, I cannot leave the chair of the Royal Geographical Society at the expiration of my second term of office, without expressing my earnest hope that our Government will at once direct the speedy execution of a good general map of Scotland, and see that an adequate sum of money be applied exclusively to that object.*

Above all, I again urge the Highland proprietors to unite to secure their due share of this national grant, and to check its application to purposes alien to their interests, and which, if persevered in, will infallibly deprive them of a *map* in this generation.

NOTE.—The following are copies of a circular sent from the Treasury to the President of the Royal Geographical Society, and his reply:—

SIR, *Treasury Chambers, 20th April,* 1853.

THE following correspondence and memoranda describe—first, the grounds upon which it was determined, in 1840, to publish the Ordnance Map on the scale of 6 inches to the mile for the country, and 5 feet to the mile for towns; and, secondly, the opinions now given on the question, whether the purposes which a national survey ought to subserve would be more fully provided for by an increased scale; and how far such increased scale would involve increased expense.

The Lords Commissioners of Her Majesty's Treasury request that, after having attentively read these papers, you will state, in the annexed form, what scales you would recommend for any National Surveys which may henceforward be carried

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* Whilst these pages are undergoing a revise I am happy to learn from the Right Hon. W. Gladstone, M.P., the Chancellor of the Exchequer, and the Hon. F. Charteris, M.P., that "there is no question of extending the large scale to the Highlands and uncultivated districts of Scotland which are only suited to a 1-inch general map." As regards the cultivated districts the surveyors are, it appears, occupied in obtaining the information necessary to enable the Government to determine the scale which should in future be there adopted. It also appears that the necessity of speedily completing a 1-inch map is quite admitted.—June 30, 1853.

on at the public expense; and that you will add any special observations you may have to make in support of your opinions.

It is assumed that the results of the Ordnance Survey will, under any circumstances, be separately published on the reduced scale of 1 inch to the mile; and the question upon which an opinion is solicited, is merely between the scale of 6 inches and any larger scale.

I have the honour to be, Sir,

Your obedient, humble servant,

The President of the Royal Geographical Society, &c. &c. C. E. Trevelyan.

Sir, *Belgrave Square, 25th April,* 1853.

In answer to your circular of the 20th April, I beg to state that, having formerly, and especially in my printed evidence before the Committee of the House of Commons (1851), fully expressed my views regarding the relative merits of maps of Scotland on the scales of 6 inches and 1 inch to the mile, I shall only briefly recur to that question in the few general observations with which this letter concludes.

In regard to the question of the adoption of the 6-inch or a still larger scale, on which my opinion is asked, I recommend that the survey be made on a scale of 24 inches to the mile, that draft plans on that scale be preserved as public records, and that the engraved plans for sale (relating to such parts of Scotland as require them) be on a scale of 12 inches to the mile, rather than on one of 6 inches, and for the following reasons:—

1st. The 6-inch map is too large for a general map, and too small for an estate map.

2nd. The 6-inch map is too small to admit of accurate measurement of areas, especially of less than one acre, as is acknowledged by the advocates of that scale (Correspondence, p. 28, 29).

3rd. The 6-inch maps have been found wholly inadequate for the purposes of the Tithe Commutation Act, the Parochial Assessments Act, and the Inclosure Act, so that additional surveys on a large scale have been found necessary for all these purposes (Correspondence, p. 31).

4th. The 6-inch maps cannot be applied with safety and convenience for the registration of sales or transfer of land, assurances or encumbrances of property, or other similar purposes contemplated by Lord Langdale (Corresp., p. 23), or for several of the purposes enumerated by Lieut.-Colonel Dawson (Corresp., p. 32).

5th. That whilst the 6-inch plans are too large for the general, geological, or mineral survey of the whole kingdom, they are too small for the detailed plans of the richer mineral and coal districts, on which the course of mineral veins, the out-crop of coal-seams, beds of limestone and sandstone, and the distribution of other useful substances, would require to be laid down.

6th. From the statement of Colonel Dawson, and other competent authorities, it appears that a survey on the scale of 24 inches to the mile, with engraved plans on a scale of 12 inches, is fully sufficient for these purposes, and likely to meet the wants of the nation for many years to come.

7th. That changes of boundaries, roads, new houses, and other alterations consequent on increase of population or improvement of the land, can be more readily entered on the plates, if the larger scale be adopted.

For these and other reasons, I recommend that, if the Government is to incur the great expense of surveying and engraving Scotland on a large scale, the 12-inch plan be preferred to that of 6-inch dimensions, the difference of expense* being more than compensated by the superior advantages of the larger scale.

In thus recommending a larger scale than 6 inches for the plans, I desire that it

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* The 6-inch plan costs 5*d.* per acre; the 12-inch costs 7*d.* per acre.—See Corresp., p. 44.

may be understood that I have in no respect changed my opinions regarding the relative merits of the 6-inch and 1-inch maps, as expressed in my published evidence before the Committee of the House of Commons. The correspondence now printed, with the general demand for plans on a large scale, only more fully confirms and bears out the views there explained of the comparative small value of the 6-inch maps. *I am still as firmly as ever of opinion that a 1-inch map is all that can be required for large portions of the Highlands and other wild and mountainous tracts of Scotland.*

I must also express my fears that the time requisite for the production of a minutely accurate survey on the large scale, and for drawing and engraving such vast outline plans, will occasion so much delay, that the present generation cannot expect to see the completion of the 1-inch map of Scotland, at length promised by the Government and so long desiderated by geographers and the public.

I think, therefore, that the publication of an useful and accessible map of Scotland, available for all purposes of county or national improvement, should not be made dependent on the preparation of plans on the large scale.

It was, indeed, my anxious hope that the beautiful system of mapping on the scale of 1 inch to the mile, which had been so very successfully applied by the Government surveyors to North Wales (and where no survey on the large scale was ever made) should have been extended without loss of time to the Highlands of the North.

It was this feeling, quickened by a sense of humiliation in the reflection, that Scotland stands almost alone in Europe as a kingdom without a map, which urged me to rouse public attention to the fact, first in 1834, and subsequently in 1850.

The strong impressions I entertain on a subject I have so long considered, must be my apology for requesting you to give publicity to the opinion of

Your very obedient Servant,

Roderick I. Murchison.

To Sir Charles Trevelyan, K.C.B., Treasury.

The Alps—Switzerland.

German Maps.—Austria, Prussia, &c.—If I formerly spoke in praise of the labours of Austrian topographers, among the most accomplished of whom is our Foreign Associate, H. I. Highness the Archduke John, I must now crave your attention to the very great strides, which have been made by Austrian geologists in their preparation of special maps of their vast and diversified empire. Having visited Vienna at different periods during the last 24 years, I had to regret, during much of that time, that, whilst botany, mineralogy, and topography were flourishing, the true geological structure of the empire was comparatively so neglected, that, notwithstanding the exertions of one or two individuals, passing visitors like myself were enabled occasionally to throw some light on the chief relations of the rocks of the Eastern Alps and other Austrian regions.

That state of things has, I rejoice to say, entirely passed away in the last few years, owing to the hearty union of some good native friends of science, led on by Professor Haidinger. Leaving his retirement at Gratz, and joined by M. Boué, M. Franz von Hauer, and a few other persons, that excellent mineralogist and patriotic philosopher

formed, in the first instance, a private society, the 'Montanischtische Museum,' which soon elicited a proper desire for accurate geological surveys. In the spring of 1847 the establishment of an Academy of Sciences having given a fresh impulse to the subject, pupils were despatched, to learn the method of working in the British School of Mines and Geological Survey, who have subsequently produced in Austria some very remarkable results.

A systematic geological survey is now, indeed, a concomitant of the topographic map, and measures are taken to determine annually, 400 square miles of country; so that, as the empire consists of about 12,000 square miles, it is estimated that the whole of it will have been completely described in about 30 years. This field-work, illustrated as it is at meetings held every week during the winter, at the Imperial Geological Institute of Vienna, at which memoirs on every affiliated branch of science are also read and discussed, and the results of chemical and metallurgical examinations reported, has created quite a new æra in the Austrian metropolis. In all this advance I recognize the skill and energy of my friend, M. Haidinger.

It is also gratifying to know that one of our Foreign Members, M. Hammer von Purgstal, who occupies a leading station in the empire, has also been instrumental in the formation of such a noble establishment. The volumes which have been issued to the public are works worthy of every commendation. It is, however, of the last published maps that I can now only speak before the Royal Geographers, or those with which the names of Morlot, Haidinger, and others are so honourably associated. It will doubtless be the especial duty of the President of the Geological Society to extract the intrinsic value of the books of which these maps are the illustration.

Another Austrian establishment, the Ferdinandeum, of Inspruck, has published a large and instructive geological map of the Tyrol, in sheets; a work of intense labour and detail, which, independently of its geological merits, I strongly recommend to all geographers who may visit that highly varied and beautiful region, with the view of learning to what extent its outline is dependent on the structure of its rocks.*

Our Austrian associate, General Hauslab, has recently encouraged, in the most effective manner, hypsometrical observations, which have led to the best results. Under his auspices Major Streffleur, Director of Public Works, has executed a rilievo, which is called by its author

* Persons wishing to acquire this map should apply to Dr. Lindner, Ferdinandeum, Inspruck.

a plastic map of Austria. Without reference to the characteristic forms of the masses, Major Streffleur has represented horizontal prismatic strata, and thus gives a general view of the elevations and depressions of the country.*

The brothers Schlagintweit, who, belonging to the active and stirring school of Prussian geographers, are worthy pupils of Humboldt and Ritter, and have already distinguished themselves by their observations on the heights, climate, springs and glaciers of the Alps, have been again at work in that region. Dr. Adolph Schlagintweit has sent us a short memoir on the physical geography and geology of Monte Rosa, extracted from a work about to be published by himself and his brother, on the physical geography and geology of that region. The work justifies the expectation of much additional information respecting the complicated structure of this giant of our European chains. It describes the mineral structure of the mountains around Monte Rosa, and shows that the dominant features of the district are owing to the elevation of a central mass of gneiss, which has thrown off the overlying grey and green slate with interstratified serpentine, in all directions. It is accompanied by a notice on the elevation of Monte Rosa, derived from various barometrical observations, from which it appears that the height of Monte Rosa is 14,284 French feet, or 15,223 English feet; thus very nearly equalling Mont Blanc in altitude.

Switzerland.—Having called your attention last year to the beautiful topography of parts of the map of Switzerland, prepared by M. Ziegler, of Winterthur, it is now my pleasing duty to direct your notice specially to the continuation of that exquisite work, illustrating the Cantons of Appenzell and St. Gallen, and particularly to the remarkable feature around the great advanced sentinel of the Northern Alps—the Hohe Sentis,—whose geological structure has been so thoroughly illustrated by M. A. Escher von der Linth. In association with its chief constructor, the eminent geologist Studer, MM. Escher and Ziegler have forwarded to us the geological map of their native country, Switzerland; it is a monument of the arduous labours and skilful interpretation of many good geologists, one of whom, M. Favre, of Geneva, has recently been among us.

I cannot make the briefest allusion to the continuation of labours which will complete the topography of Switzerland, without expressing my satisfaction that you have added the name of M. Ziegler to your

* The Austrian minister at our Court, Count Colloredo, who is an accomplished astronomer, attended our anniversary festival.

list of Foreign Correspondents. For he is truly a good correspondent; not only by sending to us the work now in progress of execution by himself and associates, but also in communicating notices of the existing surveys in various parts of his country. Thus, in a recent communication, he furnishes us with accounts of the various Cantonal publications,—the recent surveys of mountains and glaciers along the Italian frontier, in which Professors Studer and Ulrich have been engaged, including a record of the phenomena of the great débâcle of 1818 in the valley of Bagne, and sketches of the 22 glaciers which feed the river Dranse.

A most important paragraph in this communication also informs us that, whilst the Swiss triangulation disagreed in the slightest degree only with the French, Bavarian, and Lombard determinations, there was a considerable and constant difference in relation to the Austrian observations along the eastern frontier, from the Grisons to St. Gall. It is, therefore, to the credit of the Austrian Government that it should have ordered that complete revision of the primary triangulation of that region, which was long ago considered necessary by Humboldt. For the perfect completion of this work, and for the erection of new signal-stations, the adjacent Swiss Cantons have given free access to their States.

Other advances made by the Austrians have also a real bearing on Switzerland, among which the commencement of a bas-relief of all that country, by M. Paulini, of Vienna, on the scale of one mile to 1¼ inch, and comprising 72 parts, is the most remarkable. Being constructed of raised paper, it is so small (to say nothing of its portability) that the separate portions of it will occupy no more space than ordinary-sized volumes on the shelves of a library.

Sardinia and Piedmont.—It was gratifying to me to direct attention some years ago to a very remarkable map of the Island of Sardinia, executed by that accomplished geographer, General Alberto della Marmora; and when I last traversed the Alps of Piedmont, I rejoiced to see how much progress had been made in delineating the features of that region, which, in all ages, has been of such high interest to the military topographer.

We have recently received, through our Correspondent at Turin, the Chevalier Cristoforo Negri, a summary of the progress and actual state of the cartography of that kingdom, drawn up by Captain Charles Dal Pozzo di Mombello, of the Sardinian Staff, which demonstrates that this small and flourishing kingdom has realized the same geographical objects as the largest and richest states.

In the last century the maps of Piedmont, like those of most parts of Europe, were very defective, and, in the early part of this century, the continuance of war prevented the establishment of a correct survey; the only general map then in use being one on various scales, made by the engineer Borgogno, and of which there was a map reduced to one scale by M. Morno. During the French dominion in Italy a cadastral survey was begun, but it was only after the restoration of the Royal Family, and during the subsequent peace, that great geographical works could be successfully carried out. France had then measured the meridian between Dunkirk and Formentera. Perpendicular to this she had also measured an arc from Bordeaux on the ocean to the frontiers of Savoy; whilst, in the same direction, Austria had on her part finished an admeasurement from Fiume on the Adriatic to Rivoli, near Turin.

It remained for the Sardinian Government to complete the great line of the measurement of an arc across her snowy Alps. This operation was commenced in conjunction with Austria, and executed by a joint commission, composed of topographers and astronomers of the two countries. Large triangles were abandoned, owing to the great irregularities of the ground, and those of medium size adopted. These observations, commenced in 1822, produced determinations of latitude and longitude, and fixed the azimuth of the different triangles; and, through the concurrence of the French and Swiss astronomers, the important result was obtained in one night, by fire signals, of the difference of longitude between the Hospice of Mount Cenis and the point of Solignat, in the heart of France. The details by which these great data were obtained, and the Alpine interval filled up, are so accurately given by Captain Dal Pozzo, that I hope his notice will be published in our volumes, as a record highly interesting to practical geographers. In it our associates will also find a good account of the methods employed for the exact determination of all the heights, from the faro of Genoa to the highest Alps; whilst the completion of the zenith distances is all but completed. It is also to be stated that Sardinia has for some time possessed a general map of all her dominions on the scale of $\frac{1}{50000}$, the lithographic sheets of which are now being issued at a very small cost to the public. The list of all the other works executed by the Sardinian Government, which is given by Captain Dal Pozzo, must increase our desire to possess such valuable documents, which illustrate the highly diversified topography of a region inhabited by so intelligent and industrious a people, and who have always maintained their independence amongst their native mountains.

Mountain Systems of M. Elie de Beaumont.

Looking to the too great length of this address, and seeing how well the progress of what may be called the "Home Geography" of Europe is made known through many channels, I shall on this occasion refrain from alluding to the various maps and charts of France and England which have been published. But I must speak of a work by my eminent friend M. Elie de Beaumont, entitled 'Essai sur les Systèmes de Montagnes,'* which well merits your attention for its bearing upon physical geography.

The chief object of this work, which embodies certain leading views promulgated by the author in the last twenty years, is to show how mountain chains have received their principal elevation and main direction at particular periods in the history of the earth;—such periods of great physical disturbances agreeing, to a great extent, as he believes, with distinct and successive geological formations.

I am not here called on to discuss those geological views which have given rise to much controversy, illustrated as they are by an ingenious mathematical theory, which has already been scrutinized by Mr. Hopkins, the late President of the Geological Society. We may, however, thank M. de Beaumont for inciting us to work out with accuracy the direction of mountain chains. For, to use his own powerful language, "The study of these features constitutes the very essence of topography, and their careful analysis may enable us to obtain general laws. These signs of the revolution of the surface are, in short, the mutual links between the daily wear and tear of the elements, as determined by the present relief of the ground, and all former events which fashioned out that outline.

"In endeavouring," he adds, "to co-ordinate the elements of the vast assemblage of characters, by which the hand of time has engraved the history of the globe upon its surface, it has been found that mountains are the capital letters of this enormous manuscript, and that each system of mountains constitutes a chapter." †

Ancient Geography.

In concluding the address of last year, I reminded you that our volumes occasionally contained contributions of great merit on comparative or ancient geography. In the twelve months which have elapsed, several subjects of this nature have been brought before us. The first

* Paris. Bertrand. 1852.
† Notice sur le Système de Montagnes, p. 3. Paris. Bertrand. 1852. 3 vols.

of these was an elaborately detailed journey of the celebrated American traveller, the Rev. Dr. E. Robinson, through various tracts of the Holy Land. This memoir throws light on topics of profound interest, and, when published, will doubtless much gratify our readers. Another paper of this class is an account of a brief excursion to the supposed tomb of the prophet Ezekiel, and the sacred cities of Nazif and Kirbelah, to the west of the Euphrates, by Mr. T. K. Lynch, and communicated to us by our medallist, Colonel Rawlinson.*

Besides these, I have also lately had placed in my hands a series of original papers relating to regions in Greece and European Turkey, which General Jochmus, formerly of the Turkish army, and late Minister of Foreign Affairs of the Germanic Empire, has written on the spot, in exploring the sites of ancient battles or the marches of chiefs renowned in antiquity. Devoting great attention to a comparison of the localities chronicled by Herodotus, Arrian, and the classic writers, he seems to have succeeded in defining the line of march, as well as the principal halting-places, of Darius Hystaspes, from the Bosphorus to the Danube. Again, in respect to Alexander, a point probably new to historians, which General Jochmus seeks to prove, is, that the battle with the Tribelli took place on Lake Devno, and not on the Danube, as usually supposed; the further route of the great conqueror being illustrated by detailed maps. Whilst the scholar will take real pleasure in this elaborate document, and in several memoirs descriptive of ancient sites in Greece, which illustrate them in a new manner, General Jochmus brings to us contributions respecting the physical outlines of the chain of the Balkan and its passes, and affords curious information respecting the state of Bulgaria and European Turkey; subjects of deep interest to all geographers and public men. As this enterprizing officer, now about to travel in distant parts, has confided these papers to me, and as Colonel Chesney, to whom I referred them, has formed a high opinion of their merits, I trust that our Society will find the means of publishing these valuable documents on Comparative Geography.

The second expedition of our medallist, Mr. Layard, and his last discoveries among the ruins of Nineveh and Babylon, have been described by that traveller in a style so natural and so attractive, as to have insured for his work the admiration of all those who can appreciate the enthusiasm, good judgment, endurance, and perfect knowledge of the natives which it must have required to realize results so glorious to

* Whilst these pages are printing, I learn that Colonel Rawlinson has discovered cylinders with inscriptions, at Kaleh Shirgah, which indicate, he writes, a much higher antiquity than those of Nineveh, and carry back the historian to a very early age in sacred history.

our country. Although I am not gifted with the learning required to point out the whole value of such discoveries, I may be permitted to admire the adventurous spirit whose influence over wild tribes marked him out as the man who possesses, in an eminent degree, the first qualities of a geographical explorer.

And here let me remind this Society, that many of the monuments which have been recovered from oblivion, and brought to our halls by their discoverer, Layard, would have been unintelligible masses, and could have thrown no light on sacred history, but for the learning of Rawlinson. Well may we rejoice that this distinguished scholar was singled out in 1846, by one of my predecessors,* eminent for his acquaintance with comparative geography, to receive a gold medal for having read off the Persian cuneiform inscriptions on the walls of Ecbatana. That effort was followed by the still more difficult decypherment of the most extensive cuneiform inscriptions in the world on the lofty cliffs of Behistan, where the adjacent Persian writings on the wall were the means of interpreting the more copious Assyrian alphabet; thus affording the keys by which the real history of Nineveh and Babylon were opened out to us.

Asia Minor.

From the consideration of the comparative geography of Turkey in Europe, and Assyria, the transition is natural to Asia Minor—that intermediate region so full of historical recollections, and of whose geography so little has been correctly known. Various living English, French, and German travellers have indeed been good contributors, at the head of whom I naturally place my predecessor, Mr. W. J. Hamilton, whose excellent work and map obtained for him one of our gold medals.

We have, however, recently been presented with the first volume of the 'Asie Mineure' of M. Pierre de Tchihatcheff, which, when completed, will exceed in details and illustrations anything which has been yet attempted respecting this remarkable country. After giving to the world, and at his own expense, very copious illustrations of the outlines, structure, and statistics of the Altai Mountains, M. Pierre de Tchihatcheff visited Asia Minor; and the volume and map now before us are the results of four years of laborious investigations, to be followed by other volumes illustrative of the climate, vegetation, antiquities, geology, and statistics of that peninsula. The first part, or that now issued, refers only to the physical geography properly so called, and is accompanied by a beautiful large

* Mr. W. R. Hamilton, Trust. Brit. Mus.

map, which, prepared and collated by General Bolatoff, is a fine sample of good execution, and a monument of industry.

Not content with directing attention to the tombs and monuments of a region which has, as he says, been "by turns the cradle and the burial-ground of nations, of sciences, and of arts," M. de Tchihatcheff has striven successfully to make us better acquainted with that which is our special province, the grander works of nature. Such of you as will follow him through his descriptions will find that, however elaborate, they are always conveyed in language so elegant and clear, that no ambiguity is left on the mind, and all the natural objects are strikingly placed before the reader. Original and spirited, M. de Tchihatcheff has a wonderful facility of writing; and his diction, always appropriate, never, as I can testify, requires correction. You will, doubtless, admire with me the man who spends his fortune and risks his life in thus advancing knowledge; and it is peculiarly grateful to me to have been your President, when, in recompense for his successful labours, the Royal Geographical Society replaced the vacancy occasioned by the death of Leopold von Buch, by inserting in our list the name of the explorer of the Altai Mountains and of Asia Minor—who has produced works which have for ever associated him with those countries.

Projects of New Communication with the East Indies.

The communication with our eastern possessions by the line of the Euphrates, or by what may justly be called Chesney's line,* as defined by our able associate, and explained by him to the British Association at Belfast, has met with a zealous advocate in Dr. Thompson, who was for some years resident physician of the Christian hospital of Damascus Another plan of this gentleman is to construct a grand and entirely new line of railroad across Persia.

It is scarcely for us, as geographers, to try to estimate the ultimate success of the gigantic scheme of a railroad over the wilds of Persia and Afghanistan, the realization of which seems so distant; but in justice to our associate the eminent engineer, Robert Stephenson, who first threw out this idea, it is right to state that he never contemplated the execution of such a plan, until the wild countries through which a railroad must pass were brought into order, and the tracts adequately peopled.

In anticipation, however, of all such possible future projects, our

* There is good reason to believe that the Divan has a strong disposition to extend a line of railway to Constantinople. I also learn from Col. Chesney, that two iron steamers have been constructed for the Sultan, at Liverpool, to navigate the Euphrates.

first concern in this day is the construction of that line of railroad across the south-eastern parts of Europe, which will put us into the most rapid communication with our Indian possessions, whether the remainder of the journey be performed by the present overland route and the Red Sea, or by Chesney's new line of the Euphrates. With this view it has been suggested that the starting point from Europe should be Salonica in preference to Trieste and Marseilles; seeing that when the present Austrian railroad reaches Belgrade, it will then become a work of no great engineering difficulty to prolong it southwards up the river Murava, across a comparatively low watershed, and down the valley of the Vardar to Salonica, gaining thereby greatly over the journey by Trieste to Alexandria, and abbreviating the sea voyage by about one-half. By this means telegraphic communication with India would be shortened by forty-eight hours, and the route, to travellers, by at least thirty hours. The chief objection to the execution of a scheme so favourable to Austria, and affording a fine exit for Hungarian produce, exists in the passage through Macedonia, a Turkish province, in which foreigners can hold no property, and where the lands of the Christian subjects of the Porte do not afford that security required for investments of European capital. Under such difficulties the route by Marseilles, Trieste, and Fiume, may therefore be long in use before that of Salonica be made available.

In connection with the subject of intercourse with the East, we are bound specially to recollect the services which have been rendered by our associate, Captain W. Allen, R.N., in two memoirs recently read before us. The first of these, the result of a personal survey, was his account of the ancient port of Seleucia, and the causes of its silting up, with a suggestion as to the best method of opening it out. The other memoir by Captain Allen is of a much more original and comprehensive nature; for whilst it involves geographical speculations concerning the desiccation of the Dead Sea, which have an important bearing on geology, it points at the same time to the *possibility* of uniting, at a future day, the Mediterranean with the Red Sea, by inundating the great depression of the Dead Sea which lies between them.

There is certainly no natural feature of the earth's surface more astounding or more difficult of explanation, than the existence of this long, deep fissure, which, being 630 feet below the Mediterranean at the Lake of Tiberias, deepens in the Dead Sea to 1300 feet below the general sea level! With the nature of the hilly country between the Mediterranean and the Sea of Tiberias we are pretty well acquainted; and we are reminded by Captain Allen, that a line of commu-

nication might be established without traversing any very high ground. Hence it is possible that the modern spirit of enterprize might adopt the suggestion of a ship canal, as shadowed out by this officer, through which the waters of the Mediterranean, rushing for a number of years, might be cascaded into the low country, and thus submerging a great area, now pestilential and of little or no value, render the Dead Sea a south-eastern extension of the Mediterranean. But still there would remain a space of land to be cut through from the Dead Sea depression into the Red Sea; and the first question is, what is the nature of that barrier, and what its altitude?

I will not now stop to discuss the value of the ingenious theory of Captain Allen, which regards the Dead Sea as simply the desiccated bottom of a deep former bay of the Red Sea, the connecting strait with which is now occupied by the grounds of the Wadi Akabá. He supposes that the exclusion of the Dead Sea may have been produced by the formation of coral reefs, or, in other words, that a slight barrier may now only exist to prevent the Red Sea from re-occupying its presumed ancient strait and deep bay. Evaporation in such a climate would, it is believed, have sufficiently drawn off the waters of the Dead Sea, during long ages after their separation from the Ocean, and have thus brought them, by a gradual process of reduction, to their present level.

But before we can arrive at any explanation of this problem in ancient or geological geography, or form any rational conjecture of the eventual possibility of opening such a water-communication between Europe and Southern Asia, it is essential that the true physical features of the region, particularly of the tract between the Dead Sea and the Red Sea, be delineated. For this purpose the proposal of Captain Allen to effect, in his own person, a survey of such lands, accompanied by a competent officer of the Royal Engineers,* is well worthy of our country, and will, I hope, be ordered by Her Majesty's Government; if only to clear up the obscurities respecting this singular region, and to determine with accuracy the relative heights of a country so near to the birth-place of Christianity, and which was the site of so many events recorded in Sacred History.

ARABIA.

In carrying out the wishes of British geographers, to which I

* Steps were taken a few months ago to carry out this project, and General Sir J. Burgoyne, with whom I consulted, was quite prepared to furnish the requisite engineer officer, but the season was considered too far advanced. I trust that the Government will sanction the execution of the enterprise next winter or spring.

adverted at the last Anniversary as connected with the exploration of the interior of Arabia, it has given me great pleasure to see, that by the employment of the small sum at our disposal for that purpose, we should have been so fortunate as to secure the services of the author of the 'Happy Valley of Scinde,' who, on his return to Hindostan, will accomplish, if possible in a private and quiet manner, a journey across the interior portions of Southern Arabia. Lieutenant Burton does indeed seem to me the very person fitted to accomplish such an enterprise, whether we look to his capacity for observation, his knowledge of Arabic and other Eastern languages, or his facility of assuming the character of a travelling Mussulman. I repeat my conviction, that there is no tract with which it more behoves our rulers to open out a friendly intercourse than the centre of Southern Arabia, situated as it is in the direct line of communication between Hindostan and Europe, and containing valuable supplies of horses, and other natural productions, which ought to be re-opened to the civilized world.

Attaching great importance to the success of this enterprise, I feel quite certain that it is in excellent hands, and I trust that Lieutenant Burton will give us a perspicuous account of his wanderings through a region so famous in ancient history, and of which we are now so profoundly ignorant.

New Maps of Hindostan.

Having spoken last year at some length of the great northern mountain-barrier the Himalaya, which separates our eastern possessions from Tibet and China, let me now direct your attention to the last year's labours of the veteran geographer and founder of the Geological Society of London, my valued friend Mr. Greenough. Whenever the day shall come—(and may it be far off!)—when the person occupying this chair shall be called upon to treat of the labours of this distinguished man, then will there be poured forth an enumeration of his works which will satisfy mankind, that in this generation no individual among us has accumulated greater stores of geographical and geological knowledge; and that no one has made greater efforts to generalize detached data, and group them together for the benefit of our race. On this occasion it only behoves me to speak of one of his last efforts, or that of the illustration of Hindostan, as put forth in maps exhibited before the Royal Asiatic Society. Defining on one of these, each of the ten water basins of the peninsula, and noting all their affluents, and the number of square miles drained by each, he read a valuable memoir to the Asiatic Society. Another work, and that to which I now particularly

advert, is a grand original, physical and geological Map of all India, about 7 feet long and 5¾ feet wide, which he has prepared himself, directing the insertion of every stream and hill, and sedulously consulting every authority for the geological attributes of each district between the plateaux N. of the Himalaya and Cape Comorin. On this Map the spectator sees the delineation of coal tracts, the larger portion of which are unquestionably of tertiary age, and not like the old coal of Europe and America; the range of the diamond deposits; the vast territories occupied by granitic and eruptive rocks; the demarcation of masses of secondary age, in which the cretaceous deposits of the age of our chalk play so subordinate a part, whilst the nummulitic formation, or oldest tertiary, has so grand a development, particularly in the north; the Silurian and other palæozoic rocks also being only known in the north-western extremity of the Punjaub and in the Himalaya mountains.

Such a labour of love as this on the part of such a man, seems to me to call not only for the special acknowledgments of all geographers and geologists, but also for the approbation of the Board of Control and Directors of the East India Company, who would do real service by publishing this great map, and thus render the name of Greenough as well known in our Eastern Empire as it is in Europe.

CHINA.—ARACAN.

If at our last anniversary we adverted to the natural features of China, which had recently been described in the works of the Missionaries Huc and Gabet, or of our enterprising countryman Fortune, there is now opened out to us a vista of unbounded interest.

Internal political commotions have reached such a crisis, that whether the Old Imperial Dynasty be sustained, or a new order of things be established, it is highly probable that the powers of Europe and America will soon find a much more open road for their commerce in that great empire.

Whilst geography and all the affiliated sciences will, no doubt, largely profit by this discovery, as we may call it, of China, it may be doubted whether even the gold of Australia and California will have created greater changes in the establishment of new seats of power, than this unfolding of that hitherto unknown and rich region of the earth. Already, indeed, tens of thousands of Chinamen have sought and gained their livelihood by industry in the islands of the Indian seas, California, and other lands.

The strong frames of this people, and their adaptation to labour in the hottest and dampest soils, specially qualify them to carry out enterprises in climates where Europeans would fall victims to malaria. The

extension, therefore, on the one hand, of their redundant population to regions which call for improvement, and the introduction of foreigners into their own country for the purposes of trade and commerce (if ever realized), would form a grand social revolution more influential on the future prospects of mankind than the conquests of a Tamerlane or a Genghis Khan.

The view which now lies open to geographers, geologists, and travellers, is truly so full of excitement, that, as one of a race eager for fresh knowledge, I only regret that my sexagenarian condition prevents my hoping to take any share in the first real geographical explorations in the Chinese empire.

In briefly alluding to China and the East Indies, I may remind you that we were gratified last session by the reading of an interesting memoir on a portion of the province of Aracan, the author of which, Captain Tickell, enlivened his paper with clever sketches, which conveyed to us clear ideas respecting the customs, habits, and costume of the people who inhabit the banks of the river Koladyn.

Africa.

The progress made by the government expedition to explore Central Africa, which was originally planned by the lamented Mr. James Richardson, with whom Drs. Barth and Overweg were afterwards associated, calls first for our notice. Although Richardson was cut off before he could mature his project, he has left us, in the interesting diary of his last adventures in Africa, as published by his widow, full proofs of his capacity to accomplish his arduous mission, and of the sincerity with which he applied himself to better the condition of those natives in and beyond the great Sahara, of whose habits and manners he has given us such graphic delineations. These memoranda, written on the spot, and tinged with a shade of melancholy which seemed to presage his death, breathe the spirit of an enlightened man and a determined traveller, who willingly sacrificed life and everything in the hope of diffusing the blessings of civilization, commerce, and religion, through those benighted regions.

Other and subsequent features of this mission are recorded in newspapers and periodicals, from which I have gleaned partial information; though I should naturally have preferred to have had the necessary documentary evidence which reached our country laid before this Society. The want of this knowledge has alone prevented my previously rendering justice to the brave men who have been engaged in this enterprise.

Since the last anniversary I have, however, been informed, through the Chevalier Bunsen, who has taken a lively interest in this expedition, and also through Mr. Petermann, that the travellers Barth and Overweg accompanied an army of the Sheikh of Bornu, hoping to explore the region to the east of Lake Tchad, as far as Borgu and Wadai, but that army being defeated and put to flight, they only saved their lives and instruments by a quick retreat.

Having again reached their residence at Kuka, they next joined another razzia, led on by the Vizier of Bornu himself, directed against the Sultan of Mandara, a country to the south of Bornu, already known through Major Denham, who there met with a narrow escape on a similar mission. On this occasion the army was more fortunate, the enemy retreating as the former advanced; and thus the travellers were enabled to proceed at least 100 miles further than Major Denham in his memorable excursion, and were only there stopped by the Ter-benel, a very considerable river running into the Tchary. The regions visited are described as most fertile and rich. From the end of March to the end of May last year, Dr. Overweg made a successful journey from Kuka in a south-westerly direction, and reached to within 150 English miles of Yacoba, the great town of the Fellatahs; while Dr. Barth went south-east on a journey to Baghirmi, a powerful kingdom between Lake Tchad and the Upper Nile, which had never been previously visited by any European. Dr. Barth reached Máseña, the capital of the country, on the 28th of April last year, which place formed his head-quarters during the three succeeding months. He collected, as I am told, a large mass of information respecting the history, geography, and ethnography of Baghirmi and Waday, which he has embodied in an account addressed to the Foreign Office. He returned to Kuka on the 20th of August, and rejoined his fellow-traveller at that place. The travellers then intended to set out together on a journey to the eastern side of Lake Tchad, but Dr. Overweg soon after was seized with fever, and fell, alas! a victim to it on the 27th of September last.

Undismayed by the loss of both his companions, Dr. Barth was determined to leave Kuka for Timbuctù in November last, and after the accomplishment of this journey, to explore the regions between Adamaua and the river Kawara, or the lower portion of the valley of the river Tchadda, supposed to be the Benue in Adamaua, a splendid river, which there rises, during the rainy season, 40 to 50 feet.

Dr. Overweg's journals and papers have lately been received at the Foreign Office; and I am told by Mr. Petermann that they contain

important astronomical observations made in the Sahara, on Lake Tchad, and in the regions to the south of it. Besides these observations, which are now undergoing calculation at the Royal Observatory at Berlin, Dr. Overweg's seven weeks navigation of Lake Tchad, and his geological researches, will doubtless claim particular attention. One of the most important documents as yet sent home by Dr. Barth, is, I am informed by Chevalier Bunsen, a map of Central Africa, founded entirely on his own observations and labours, which extends from N. lat. 4° to 15°, and E. long 8° to 23°. Mr. Petermann is directed to construct for the British Government a large map of that region from the combined researches of Dr. Barth and Dr. Overweg.

Now, indeed, that Dr. Barth will soon be joined by that accomplished young astronomer, Dr. Vogel, who has been heard of as proceeding from Tripoli to Murzuk, we may anticipate great results, to one of which I shall presently allude. Already, the explorations of Barth and Overweg have revived a hope, which began to be entertained after the journeys of Lander, Clapperton, and Denham, of opening out a profitable trade with the interior tribes of Africa.

At the close of our last session, Lieut. Lyons McLeod, R.N., brought before us a project for ascending the Niger, first in a steamer to be purposely prepared for that object by Mr. Macgregor Laird, who has a contract to that effect with her Majesty's Government; and next in the higher and shallower parts of the river in an ingenious steam-launch. Whilst we encouraged this scheme, it was also taken up by the Chamber of Commerce of Manchester; and thus backed, it was brought by myself, as your President, under the consideration of Her Majesty's late Government.

In the first instance it was supposed that an expenditure of not less than 5000*l*. might be required; but on referring the case to our Expedition Committee, the more extended plan was reduced to the simple recommendation of ascending the main river as far as the steamer could proceed. The survey in this case was to be restricted to scientific observations, and to establishing the groundwork of subsequent and more extensive explorations; the expenditure in this case not exceeding 2500*l*.

The change of government necessarily delayed the execution of the project. In the meantime the last report from Dr. Barth has naturally produced a strong desire to see the original plan somewhat changed by an ascent of the river Tchadda, the great tributary of the Niger, by steam; and, if possible, to the very spot where the adventurous

German traversed what is supposed to be its upper portion (or the Benue, there 9 feet deep), in his journey from Bornu to the fertile country of Adamaua.

Every one must wish to see an enterprise realized, which brings us into communication with some of the most industrious nations of the interior of Africa, and which, by establishing a regular commerce, might go far to check the slave trade. But the period of *this* year is already passed, when alone any such enterprise could be prepared without encountering the risk of loss of life which characterised a previous expedition; for, according to Macgregor Laird and other authorities, the effort must be made when the river is on the rise.

The great feature in the new proposal is, that the Tchadda should be ascended during the rains or early in the spring (about the end of May or beginning of June), and that, forcing up by steam-power against the current, the tracts so fatal to Europeans in the hot and dry season may then be traversed without danger. But as several months are required to construct the proper river steamer, I have no doubt, from what I know of their intentions, that her Majesty's Government will authorize Mr. Macgregor Laird to prepare his vessel, and will further organize such an expedition for the early part of next spring as may ensure a successful issue. If that expedition be accompanied by a good naval surveyor, with scientific medical men, and the crew be exclusively composed of black seamen, all the prudential cautions which can be suggested will have been taken, and we may then reasonably look to the commencement of a successful commercial intercourse with Central Africa, which her Majesty's Secretary of State for Foreign Affairs, the Earl of Clarendon, now a Fellow of our Society, has taken very decisive steps to promote.

This would, indeed, be the true method of effecting the first great change in the social condition of so vast a number of human beings; for, whilst the people to whom I have alluded are by comparison in an advanced state, we learn from the explorations of the Piedmontese agent, M. Rollet, and the descriptions of the missionary Knoblicher, that the inhabitants of the region high up the Nile are in the most abject state of ignorance, and little raised above the brute creation.

If it be the destiny of Dr. Barth, and the astronomer, Dr. Vogel, to succeed eventually in traversing Africa, as they hope, and as first proposed by our medallist, Carl Ritter, from the environs of Lake Tchad to the eastern shore, near Mombas, determining by the way the outline of the true water-shed of the Nile, and revealing to us the real

state of the inhabitants, they will have achieved the greatest geographical exploit of modern times.*

In anticipation of the eventual completion of a triumph like this, we may well look with satisfaction to the rapid strides which are everywhere being made to dispel our ignorance of Central Africa. Among these, the adventures of the Hungarian, Stanislaus Magyar,† and his penetration from the west coast, near Angola, to a central point, are very striking; whilst the complete traverse of Africa by a caravan of native traders from Zanzibar on the E.N.E., to Angola on the W.S.W., of which we have had an interesting account, through the Foreign-Office, from Consul Brand, has confirmed and extended the ideas previously derived from African sources, as compiled by Mr. Macqueen, and illustrated by Mr. Cooley. The last-mentioned geographer has, indeed, given us a well-methodized memoir, explaining how the details related by the conductors of the caravan above alluded to, agree with his views obtained from Portuguese authorities, as to the form and position of the great interior lake of Nyassi which the traders traversed.

The valuable map by Mr. Cooley, to which I alluded in my last Address, has been presented to us by its learned author. In it geographers will recognize for the first time the delineation of lakes, rivers, and tracts between the equator and the southern tropic, the routes to Lake Nyassi, and across the countries of the Moenemoezi, Cazembe, and Muropue. In casting the eye on this map, English geographers may, indeed, be proud to see that very nearly the most central point of Southern Africa is the town of Sesheke, on the river Liaubac, or Luambege, reached by our associate, Oswald, in company with the missionary Livingston, S. lat. 17° 26″, E. long. 26° 50″, whilst far to the N. of this, or in S. lat. 10½°, the Hungarian Stanislaus Magyar is said to have reached the centre of a broader part of the continent in E. long. 28°.

Lastly, in relation to this most interesting continent, of which I spoke at great length at the last Anniversary, it is to be noted, that

* In Eastern Africa the Rev. Mr. Krapf continues his visits in various directions in the neighbourhood of Mombas. And in the 'Church Missionary Intelligencer' for June and July, an interesting description of the late visit of this enterprising missionary to Usambára may be read.

Our associate, Dr. Irving, R.N., has given a lively account of his mission, in company with Commander Foote, to Abbeokuta, in December last year; and as this intelligent physician is about to revisit Africa, much new matter may be safely expected from one so conversant with the inhabitants of Western Africa. —See 'Church Missionary Intelligencer' for June.

† This traveller has penetrated nearer to the equator than any modern traveller.

the portion of Southern Africa around the Lake Ngami, to which our attention was specially drawn last year, has been reached by Messrs. Green, Wilson, Edwards, and Campbell, who travelled round the lake, which is found to be about 65 miles long and 12 to 14 miles broad.*

It would appear that the Portuguese, coming from the west coast to the N.W. of Morami town, pass down the Zambese river in canoes, and carry on an active barter with some of the population before alluded to, who inhabit a rich country lower down the stream.

The new feature of interest in this part of Africa is, that whilst the river Zouga flows out of the lake Ngami at its eastern end, the large river Teougha, or Teoge, enters it from the N.W. This stream has been ascended for about 150 miles, and would have been still further explored, had not the oxen of the travellers been destroyed in great numbers by the attacks of the Tsetse fly. The longitude west was computed by Messrs. Green to be 22°. Mountains reported to be covered with snow are said by the natives to lie towards the sources of the river Teoge; and friendly relations have been established with the powerful chiefs Secheli and De Babi, who live upon its banks.

In reviewing with pride these recent efforts to extend our acquaintance with the interior of Africa, we must not forget, that whilst the ancients unquestionably knew much more of this vast continent than ourselves, the very tracts around Timbuctù, and in Soudan and Ethiopia, as well as the banks of the Upper Nile, were all explored and described in the fourteenth century by that celebrated Moor of Tangiers, Ibn Batuta, whose extraordinary travels in many other distant regions, including Hindostan, are known to the English public through Dr. Lee's translation published in 1829.†

United States.

In North America two works have been published by the Government of the United States, each of which imparts to us much knowledge of vast countries hitherto slightly known.

That singular region around the great salt lake of Utah, at the eastern frontier of the Rocky Mountains, which was partially explored by our medallist, Frémont, and which has since been occupied by the new sect, the "Mormons," has been regularly surveyed and described by Captain Stansbury of the United States Staff Corps. Accom-

* These facts were stated in the 'Graham's-Town Journal,' Feb. 12, and 'The Friend of the Sovereignty,' Bloem Fontein, Jan. 13.

† An independent Portuguese translation from the Arabic, by Moura (vol. i.) has recently been presented to our Library by His Excellency Count de Lavradio, the Portuguese Minister.

panied by detailed maps and many lithographic sketches, this work, published by the Government of the United States, has excited much interest, from its description of the singular structure of the country, and by sketches of the singular sect of people by whom it has been colonized, and who seem to bid fair to establish themselves soon as one of the independent states of the Union. The accurate survey of large tracts in the region around the great salt lake, wherein fresh water is with difficulty found, was a feat worthy of the successor of Frémont; and we cannot too highly commend the vigour of mind and ready resources, with which Captain Stansbury overcame all such obstacles.

In no region is the direct dependence of the actual condition of a country, or the geological mutations which its rocks have undergone, more manifest. Whilst the palæozoic strata (Devonian and carboniferous) undulate over vast prairies between the western boundary of the settled portion of the United States and the edge of the Rocky Mountains, no sooner do the older masses (probably Silurian) approach the latter, where eruptive rocks have been protruded to the surface, than they lose their normal characters and become variously modified. The mineral distinctions of this region are its crystalline structure, and the formation of large bodies of rock salt, which impregnate the waters derived from the atmosphere and thus render large districts sterile. There are, however, tracts of considerable extent, in which the Mormons live, which are highly fertile, and particularly the chief valley, as watered by the river Jordan, which, just as the river of our sacred history empties itself into the Dead Sea, here finds a receptacle in a similar inland sheet of water. The pages of Captain Stansbury must, indeed, be attractive to every class of readers, and to none more so than those who desire to form a just and unexaggerated account of the Mormons.

A very remarkable American work of the year is a Report of a Geological Survey of Wisconsin, Iowa, Minnesota, and a portion of Nebraska Territory, by Mr. D. Owen, U.S., geologist. When it is considered that this survey relates to a country more than twice the size of Great Britain, or 750 miles in length by 350 in breadth, large tracts of which had never before been explored, and that Mr. Owen and his associates, Dr. Norwood, Colonel Whittlesey, and others, have not merely reported on its geological and mineral structure, but have also published a geological map of so large a territory, determining also many altitudes and illustrating its climatology, it will be admitted that even the pure geographer is as much interested in these important results as the geologist and naturalist. One of the chief geological

facts ascertained in reference to the origin of life in the crust of the globe is the discovery of certain fossil animals (trilobites) in strata lower than any in which they had been found in America, but which are precisely on the same horizon as the lowest fossil-bearing Silurian rocks of Britain, Scandinavia, Russia, and Bohemia, where trilobites also occur in the same relative position. Excuse me, then, if I say that I felt no small pride when I saw that Mr. Owen had mapped all these rocks as Lower Silurian, and as agreeing with those, which under that name I have defined to be the lowest fossiliferous rocks of Europe. These and other palæozoic rocks, the equivalents of our Devonian, are surmounted by carboniferous masses of such extent, that one of them may be mentioned as a coalfield larger than England!

I rejoice in seeing the general government thus rivalling the state governments, in unfolding the real nature of the topography, geology, and mineral structure of their lands. In this way our sagacious kinsmen truly plant guide-posts for the new comers into distant settlements, destined doubtless to become at some future day powerful as European kingdoms. In commending the execution of the maps, illustrations, and woodcuts of this work, and the clear and methodical descriptions of Mr. Owen and his associates, I am lost in admiration of the great labours in the field (often under very severe privations), by which alone they could have produced a work which is a substantial addition to those volumes of Hitchcock, Hall, the brothers Rogers, Dana, Conrad, and others, which have already shed such a lustre on the geology and geography of the United States.

The very efficient manner in which the Coast Survey of the United States is conducted under the superintendence of Professor Bache has been adverted to by my predecessor. I have now the pleasure of mentioning, that the annual report of that distinguished "physicist," detailing the progress of the work during the year 1851, is, if possible, still more worthy of notice than any which have preceded it; for in this document you have before you the ways and means by which such results are obtained along all the eastern coast through upwards of 19 degrees of latitude, and can mark with admiration the rapidity with which the surveys of the western shores, or Californian coast of that continent, have been carried on. The systematic co-operation of able surveyors of the naval and military services, combined with and subordinate to a central system of direction of the Treasury, and superintended by astronomers, whose chief is Professor Bache, could not fail to make this one of the best exemplifications of applied science in modern times. The precision with which every new observation is recorded, the light

which is collaterally shed on meteorology, magnetism, the tides and currents, as well as on hydrography and pure geography, render such Reports encyclopedias of great value. Among these collateral branches I must indeed specially allude to an admirable illustration of the true nature of the coral reefs between the coasts of Florida and Mexico—the "keys" of the seamen. In a separate Report on the topography of that tract, in relation to the former, present, and probable future condition of such reefs, Professor Agassiz has successfully shown how all such surveys ought to be made in conjunction with naturalists. For, quite independent of the important additions to natural-history knowledge which are obtained, statesmen as well as hydrographers thus ascertain the causes of increase or decrease of coral reefs, and learn, that whilst no human power can arrest the growth of such reefs, there are channels amidst them which will remain deep for long periods of time, and the outlines of which, when well defined by lighthouses, may be the salvation of much life and property. In other words, the fixed and stable points of land and the channels which are dangerous, are thus accurately defined by the great naturalist, Agassiz.

Allusion has already been made to the remarkable explorations of our kinsmen in the Arctic regions, and to their gradual extension of the whale-fisheries in and beyond Behring Strait. To the current charts and recent operations of Lieut. Maury, as well as to a great expedition now in preparation by the United States, a distinct reference will be made when I come to treat of the Ocean at large. But before we quit the subject of American books, let me say that our Transatlantic brethren have eminently displayed the true interest they take in the cause of science by the recent publication of the American Ephemeris and Nautical Almanac for the year 1855, under the superintendence of Lieut. C. H. Davis, U.S. Navy, aided by Professor Pierce, and other mathematicians.* This work is truly scientific in all its bearings, beautifully printed on excellent paper, and admirably adapted for reference by the order and regularity of its arrangement. The subject-matter is divided into two distinct parts, the first of which is appropriated to nautical requirements, and is calculated for the meridian of Greenwich; the second, being devoted to the use of astronomers, is adapted for the meridian of Washington. As this book, which marks an interesting epoch in American philosophy, has hardly yet appeared in this country, a copy is now placed on the table for the inspection of Members by my predecessor, Admiral Smyth, who has thus called

* For the possession of this work, as soon as it reached England, I am indebted to Mr. Ingersoll, now Minister of the United States in London.

my attention to a work which is of so great value to all scientific geographers.

I must also seize this occasion to congratulate you on the establishment in the last year of the American Geographical and Statistical Society at New York, of which the first bulletin only has been received. I have only to regret, that at the first meeting the memoir read by Mr. Hopkins, late Consul at Paraguay, on the Geography and Statistics of that new state, should have contained certain invidious allusions to Great Britain, which I really think the author himself will, on reflection, agree with me, are ill suited to the halls of science. In no instance have the geographical, or any other scientific institutions of our country, introduced similar comparisons: on the contrary, we have always striven to promote the harmony of nations, and especially between the United States and ourselves. I feel confident, therefore, that a society, presided over by those distinguished men, Bancroft and Grinnell, will keep its future communications free from all political disquisitions. And here, I further regret to be obliged to state, that the account of the statistics of Paraguay, given by Mr. Hopkins, is at variance with the relations of other persons. Thus, the accomplished Swiss botanist, Rengger, long a *détenu* there under the Dictator Francia, estimates the population at about 200,000 (a number differing little from the old Spanish census), whilst Mr. Hopkins, possibly through an error of the press, makes it 1,200,000.

But passing from the criticism of a portion of a single memoir, let me say, that in the very same number the American Geographical Society shows the best and truest spirit, when it memorializes its Government to survey the Rio de la Plata and its tributaries correctly with a steam-vessel—a project which must meet with the approval of the geographers of all nations. Even whilst I pen these lines I hear with pleasure of a new maritime exploring expedition of the United States, consisting of five vessels, commanded by that excellent officer Captain Ringgold, which must prove as important to commerce as it is sure to produce a good survey of large portions of the North Pacific, into Behring Strait, and edges of the Arctic Ocean.

Possessing so large a portion of the sea-board of the W. coast of America, our brethren are thus taking a step of great consequence to them, whether we consider the grand trade they are opening out with China and Japan, or their new whale-fisheries. I have already alluded to a somewhat similar expedition into those seas projected by the Russians; and thus, through the efforts of the two countries most interested in ascertaining the real geography of such regions, it is by

no means improbable that, independent of many scientific and commercial advantages, the first reliable intelligence respecting the fate of our missing Arctic explorers may be brought to us by Captain Ringgold and his associates, who, expecting to be employed from four to five years in this noble service, will thus apply steam-power in a direction where Great Britain has not used it.

South America.

Isthmus of Darien.—Your attention has been from time to time called to various schemes for traversing the isthmus of Central America by a railroad or canal, and recently the narrowest part of the isthmus, or that of Darien, previously little known, has been partially explored by Dr. Cullen, and afterwards by Mr. Gisborne, who was sent out for the purpose by Messrs. Fox and Henderson. A new and mighty project has, in short, been brought forward by those enterprising men, for cutting a ship canal from Port Escoces on the eastern, to the Gulf of San Miguel on the western side of that part of the isthmus; without locks, and deep and wide enough for the passage from sea to sea of ships of the largest class: an undertaking which, however gigantic it may appear at first sight, there seems little doubt, from the information we have as yet obtained, is capable of being accomplished by modern engineering. It only rests for the merchant princes of the world to determine whether the advantages to commerce are sufficient to induce them to raise the capital, which must be provided to carry out this magnificent plan upon the scale proposed; for further details respecting which I beg to refer you to the admirable paper of Capt. Robert FitzRoy, lately read before the Society, and now in course of publication in our own Journal. In that memoir he has carefully collated all the information he could collect respecting the line of country, through which it is proposed to carry this great oceanic canal.

In alluding to it, let me do homage to the sagacity of Humboldt and say, that should this scheme be eventually carried out, it will but verify the accuracy of the predictions of the illustrious traveller, and justify his endeavours for the last forty-five years to induce us to look to the east rather than to the west of Panamá, for the line which would offer the greatest facilities for such a project. To quote his own words, in a letter to Sir Woodbine Parish, "All the secret of the isthmus lies to the east and not to the west of the meridian of Portobello and Panamá."

It will also, perhaps, be recollected that in a former address to this Society as far back as 1844, when alluding to the various schemes for

a passage across the isthmus, I mentioned that Mr. Pitman, after a careful examination of the narratives, and descriptions of the country given by the Old Buccaniers, had also arrived at the conclusion that, of the lines projected, "that of Darien was the most attractive on account of the excellent roadsteads in both seas on that parallel."

From what we now know there will not be the difficulty to which I then adverted of cutting through a cordillera; for if the eye survey which has already been made approaches to correctness, a line may be taken, which traverses no altitude exceeding 120 feet above the ocean. The real and substantial obstacle is the climate, and its six wet months, which proved so disastrous to the Scotch colony in the reign of William III., and which it is probable will render it necessary to employ Coolies, Chinamen, or other inhabitants of a hot and moist climate, to execute the task.

Whatever may be the result of the various plans for facilitating the communication between the Atlantic and Pacific oceans, which have been submitted to the public, we, as geographers, are sure to be gainers by the necessity they entail upon the projectors to obtain by every means in their power the most accurate geodesical data, respecting a most interesting portion of the western world, which has hitherto been very imperfectly delineated, though the old Spanish maps are by no means to be despised, and are indeed the only documents which can be at all relied upon.

The country of New Granada, to which the Isthmus of Darien belongs, has been made better known by a work recently published by General Mosquera, the former President of that Republic, containing much valuable information regarding its geography and resources; it comes very opportunely at this moment to meet the eager inquiries of the public respecting that part of South America. I may also refer you for much interesting information regarding the same region to the voyage of H.M.S. 'Herald,' published with the aid of her Majesty's Government by Mr. Seeman, and which abounds with interesting natural-history details of the countries north of the Equator, and bordering upon the Pacific as far north as Behring Strait, whither they were bound in search of our gallant countrymen in the Arctic seas.

The Survey of the New boundary line between Mexico and the United States, which has been recently resumed, comprising as it will a line running east and west, between the Atlantic and Pacific oceans, for upwards of 2500 miles, through a country never before scientifically explored, will no doubt be productive of results of the highest importance not only to geography but to science in general. No pains have

been spared by the government of the United States to make it so; Mr. Bartlet, their Commissioner, being accompanied by several experienced naturalists, who have already made extensive collections both in botany and zoology of great interest:—in addition to an extensive series of astronomical, magnetic, and meteorological observations established by competent officers from ocean to ocean.

Paraguay.—A diplomatic mission, despatched last year by the governments of England and France, to open a direct intercourse with Paraguay, has ascended the river Parana and reached Assumption, where, by the last accounts, the Envoys had been received in the most friendly manner by the ruling authorities. We may, I trust, therefore, anticipate that European travellers who may hereafter be desirous of exploring this interesting portion of South America, need no longer apprehend the fate of the botanist Bonpland, so many years detained there by the Dictator Francia; or even of Dr. Weddell, who so lately as 1845 was refused permission to enter the country, when he had descended the river from the Brazilian province of Cuyaba, little anticipating any impediment to his travels in that direction after Francia's death.

As it is understood that one of the objects of the mission above alluded to is to open some channel by which the various products of the interior may be brought down to the coast, and made available for the markets of Europe and North America, it may be as well to allude to an opinion very confidently expressed by Dr. Weddell, after his own voyage down the river Paraguay, that, so far as Bolivia is concerned, the easiest outlet for her productions will be by a line of road run through the province of Otuquis direct to the river Paraguay, north of the river Pilcomayo, whence the communication is easy and uninterrupted by the Rio de la Plata to the ocean.

The government of Bolivia, long impressed with the same conviction, has offered a considerable premium to the first steamer which, ascending the river Paraguay from the Atlantic, shall reach the mouth of the river Otuquis, which falls into it about 20° latitude. Our enterprising brethren in the United States will probably be the first to realize the facilities of this communication, the President having lately announced that it is his intention to equip a small steamer for the express purpose of exploring the higher waters of the Paraguay. It was supposed that either the river Pilcomayo, or the Vermejo, offered a water-communication with Upper Peru which might be made available for commercial purposes; but an attempt made in 1844 by the government of Bolivia to send a small vessel down the former river,

has shown that below Cayza it becomes too shallow for the purposes of navigation; and the fact of the Vermejo running through the Gran Chaco, which is solely inhabited by naked and hostile savages, must render that channel a very unsafe one for commerce for some time to come.

The results of the last exploration of the Vermejo by Don Pablo Soria in 1826 were supposed to be irrecoverably lost by the seizure of all his papers by the Dictator Francia. It has, however, recently transpired, that the original survey of the river, made by his pilot Delcalzi in descending it, still exists in the public archives at Assumption, where it was deposited by Francia's orders. M. Helmrichen, a German naturalist to whom we owe the information, was permitted to make a tracing of this interesting document; and although his recent death of small-pox at Rio de Janeiro has unfortunately retarded its transmission to Europe, the Austrian Consul there having taken charge of his papers, it is to be hoped that they will not be lost to the public.

Bolivia.—Dr. Weddell's narrative of his journey with M. Castlenau through the southern districts of Bolivia, has been published, as well as a brief notice of a subsequent journey in a more northerly direction, extending to Tipuani. Both are replete with new and highly interesting information respecting countries hitherto very little known and most imperfectly described.

The French government, in continuation of the objects contemplated in a former journey with M. Castelnau, have resolved upon again sending out M. Emile Deville, who was one of the same party, to complete, as far as possible, a scientific exploration of other interesting portions of the interior of the South American continent, and at the request of the Minister of Public Instruction, a Commission of the Academy of Sciences, comprising M. Elie de Beaumont and others, have marked out his route, and furnished him with the necessary instructions. He is to proceed in the first instance to Rio de Janeiro, and crossing the province of St. Paul's, follow the river Tieté to the Paranà, whence, travelling through Paraguay, he is to proceed northwards to the province of Matto Grosso, and from Villa Bella descend the Guaporé and Madeira to the Amazons, returning by Pará.* It is an arduous

* The difficulties which will probably beset this expedition, should it ever reach the southern sources of the Amazons, may be predicted from an account of an effort recently made by our associate the British Consul-General in Bolivia, Colonel Lloyd, to ascertain the capabilities of intercourse between that republic and the navigable portion of the Amazons, which document Her Majesty's Secretary of State for Foreign Affairs has permitted me to peruse since the address was delivered. Having penetrated from Cochabamba across the Cordillera which separates the dry and healthy region of Bolivia and Peru from the perpetually humid and pestiferous

undertaking in which M. Deville has the best wishes of every geographer and geologist, whilst it must be acknowledged that the liberality with which the government of France is always ready to promote such enterprises, and to aid in the publication of their results, well deserves our grateful thanks.

Chili and Peru.—The physical geography as well as natural productions of the countries bordering upon the Pacific—thanks to the indefatigable labours of Gaye and Domeyko—are now known with much more accuracy than before. Their mineral riches seem as various as they are inexhaustible.

Colonel Lloyd, now her Majesty's Consul-General in Bolivia, and so very creditably known to us in our early days as the author of the first good physical paper on the American isthmus, recently came before us as the contributor of a highly interesting Report, addressed to His Royal Highness our Vice-Patron. In it we have a very able account of the great quantity of silver which is likely to be produced in the Chilian province of Copiapo alone, whilst the search for new veins of the precious metals was leading to further explorations of the Andes: these promise ere long to make us as familiar with that portion of the Cordillera as we are with the sea coasts which bound them, and which have been so carefully surveyed by our naval officers.

A work has been lately published at Geneva, on Peru, by our corresponding member Professor Paul Chaix, giving an account of the first discovery and conquest of that portion of America by the Spaniards, which, though not professing to give much new matter, will, no doubt, from the known ability of the learned author, become a popular book among French readers.

On a more magnificent scale a great work has been recently pub-

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tracts on the east, and having advanced after very great privations and at much risk (nearly all his people being laid up with ague and fever) to beyond the Indian settlement of Chimore, on the river of that name (an affluent of the Mamore), Colonel Lloyd returned to his post under the conviction, that no valuable commercial intercourse can be established by passing through a country in which during many months the numerous rivers unite and form one great system of lakes; where the hot, moist climate, and rank vegetation are peculiarly hostile to white men; where the air is darkened by myriads of insects; and where scarcely any change of season purifies the atmosphere! As I know that Colonel Lloyd is a person who can surmount many a real obstacle, I think that his Report must be considered as quite decisive on the point of intercommunication along that line. It is, however, possible that on reaching the River Grande or Guapai the French expedition may find a more practicable intercourse, far to the east of Lloyd's line of exploration.

At our last meeting, a Memoir, accompanied by a map, on the Rio Negro, or head-waters of the Amazon, by Mr. A. R. Wallace, was laid before the Society, and has been directed to be published in the Journal. This exploration has proved the author to be well qualified to develope the natural-history products of any region, and I am happy to learn that he contemplates a survey of the Indian Archipelago.

lished at Vienna, entitled 'Antiguedades Peruanas,' by Don Mariano de Rivero, Director of the National Museum at Lima, aided by Dr. Von Tschudi, the well-known author of the 'Fauna Peruana,' and of a highly interesting book of travels in that country (now translated into English), of which I cannot speak too highly, whether as an example of the costly and highly finished style of Austrian lithography (almost rivalling, in accuracy and beauty, the illustrated work upon Mexico published by Lord Kingsborough); or as an invaluable contribution to the history of the early Peruvians—of the political and religious institutions of the Incas and of the state of the arts and sciences in Peru, as exemplified in their public works and manufactures. No expense has been spared by the Peruvian author to do honour to his country in this splendid publication.

AUSTRALIA.—ITS GOLD—ITS GEOGRAPHICAL EXPLORATION.

The golden shower which has been distributed over our great Australian colonies has been realized to an extent beyond any imaginable former estimate; for no one could have attempted to predict the quantity of auriferous wealth of any given spots in unexplored regions, though a geologist like myself, anticipating from their structure, in 1844, that gold would be found in them, was aware, as early as 1846, that specimens of the precious metal had even then been detected.*

The coincidence of mineral structure which I pointed out between the eastern watershed of Australia, as described by Strzelecki, and the Ural Mountains which I had examined, is now seen to be accompanied by other phenomena common to the two chains, to which it is well to advert. The Ural Mountains are notably auriferous on the eastern or Siberian side only; and as far as surveys have gone, it would appear that one flank only of the Australian watershed exhibits rich accumulations of gold débris; but in this case it is the western or interior side of the range. It is, however, to be observed, that in his recent exploration of vast tracts along the southern frontiers of the colony of New South Wales, where they unite with the Province of Victoria, as described in reports printed by order of the House of Commons, the Rev. W. B. Clarke has shown, that whilst no copious deposits of large-grained gold (with a partial exception near Araluen) have been found on the banks of those rivers which flow to the E. or S., yet still that in many localities, and over a very wide area, fine-grained gold is disseminated through the alluvia. In clearing up the geological structure of that region, this author has also given reasons for supposing that the

* See anniversary discourse of 1844; and 'Russia and the Ural Mountains,' vol. i., p. 392.

various affluents of the Snowy river which descends to the S. from the high Alps, named Mount Kosciusko by Strzelecki, may be profitably worked for gold when the richer natural magazines are exhausted. But still the fact remains, that it is only on the interior flank of the watershed that the great prizes have been found. Such are the tracts of Victoria, whether around Mount Alexander and along the banks of the Loddon, which flows into the Murray, or the Ovens Diggings to the N.W.; such are the rich accumulations along the feeders of the Macquarrie to the W. of Bathurst; those near Wellington, as described in a report of the Surveyor-General Sir Thomas Mitchell, and numerous fresh auriferous spots noticed by Mr. Stutchbury in his successive mineral reports; such again are the numerous creeks which supply the head-waters of the Peel river. Another striking similarity to the Ural Mountains is, that like them the Australian range is in many parts a mere plateau with a scarcely perceptible dividing ridge, along which, however, eruptive or metamorphic rocks peer out, at numerous intervals, rising, though rarely, to altitudes varying from 3000 to 6000 feet. Thus, at the source of the west-flowing Peel river, the Hanging Rock of the colonists, is an eruptive boss like the Katch Kanar of the Ural,* from which various fissures and chasms are said to radiate, in which minor streams meander through slaty and quartzose rocks, which have been the chief sources of the gold ore. In like manner Mr. Stutchbury describes numerous protrusions of granitic, syenitic, and other igneous rocks through metamorphosed strata of schist sandstone and limestone of palæozoic age around Wellington and in the affluents of the Macquarrie. Noticing the same general cause and effect in the loftier southern Alps of this chain, Mr. Clarke goes still further in his effort to discriminate a succession of igneous phenomena, showing (if I read his reports aright) that the gold is sometimes diffused, though in minute quantities, through the granite itself. The same author has also discovered traces of quicksilver and tin.

But I am not here in the capacity of a geologist, nor do I venture to speak of the varieties of intrusive rock, whether they be granites, syenites, porphyries, or greenstones. It will be rather the province of the President of the Geological Society to estimate and compare the value of labours respecting these and other mineral products, including traces of other native ores; though in referring to geology I must express my thanks to Mr. Clarke for having first elicited the fact of the presence of fossils of true Silurian age in some of the less metamorphosed limestones of the S.W. tracts of New

* I gather this from conversation with Mr. Stuart Donaldson and from a Report of Mr. Hargraves printed in the last Blue Book.

South Wales and the adjacent region of Victoria Land, and also for having indicated the intersection of certain rocks, near to which metallic ores prevailed; since these are phenomena which have been observed in other auriferous regions.

In referring to a Memoir on the Auriferous Rocks of Victoria, by Mr. G. H. Wathen, which was read before the Geological Society,* I was indeed gratified to find, that the very rich tracts around Mount Alexander present exactly the same phenomena as I had described in the Ural Mountains,† in the accumulation of the loose auriferous detritus, which is piled up at various altitudes above the present water-courses, and was manifestly placed there by much more powerful bodies of water than any which now flow in the valleys. I further learn from several sources, and particularly from Mr. Stuart Donaldson, who has travelled extensively along nearly the whole of the gold-bearing regions in both colonies, that the spots which are most copiously auriferous are the slopes which face abrupt precipices on the sides opposite to which the smaller streams, rivulets, or water-creeks of the present day flow.

Whilst I have reason to believe that not less than near 20 millions sterling have been extracted from Victoria and New South Wales in the last year, it must be borne in mind, that all this vast produce has been gathered out of what geologists consider the mere upper rubbish of the surface of the earth, which has been spread at all elevations in former periods of powerful abrasion, and when our present continents were subjected to powerful denudations by water. Let me repeat, therefore, an opinion I have so often expressed, and which is now sustained by numerous fresh proofs, that the *chief* bunches or strings of gold having been found towards the *upper part of the veinstones* in which the ore was originated, a former destruction of the sides of these mountains which were auriferous, and the wear and tear of ages have naturally brought together for the use of man, by the application of comparatively little labour, those ready-made deposits of the gravel of gold, by the discovery of which he has been enriched in all ages. On the other hand, as no mines worthy of notice have yet been established in the solid rock of Australia, neither is it likely that any such will be sought for so long as the

* Quart. Jour. Geol. Soc. Lond. vol. ix., p. 74.

† See Russia in Europe and the Ural Mountains, 1845, vol. i. p. 471, et seq.; On Australian Gold, as then known to me, Trans. Roy. Geol. Soc. Cornwall, vol. vi. p. 324, 1846. Quarterly Review, vol. lxxxvii., p. 396; Trans. Brit. Assoc., Advt. of Science, 1849. Trans. of Sect. p. 60.

gravel, sand, or shingle of certain districts affords such notable quantities of the metal.

Australia will doubtless undergo the same changes as Europe, Mexico, and South America; for the history of the gold-miner is the same in all countries. So long as the precious thing is to be had in the superficial débris of newly-colonized tracts, he clears the ground with great profit; but afterwards, when he endeavours to extract it from the solid rock, whose *original surface*, as broken up by great former operations of nature, gave rise to the copious golden deposits which have been spread out at various levels, the result is too often fallacious. For, although cases have occurred and will again occur, wherein profitable gold-mines are opened in the solid rock, the majority of such enterprises fail, whether from the irregular dissemination of the ore in a hard and intractable matrix and its usual thinning out downwards, or from the great expense of its extraction. Those persons, therefore, who are apprehensive that gold is becoming too abundant for modern requirements (a fear in which I do not participate), should first look to the new maps of Eastern Australia and the Victoria Province, prepared by Mr. Arrowsmith (particularly to the very detailed map of the gold-bearing region near Mount Alexander, as taken from the trigonometrical survey of Mr. Urquhart), to see how small are the really auriferous areas in comparison with the remainder of that continent. They should then reflect on the fact, sanctioned by the experience of ages, that when the broken materials on the surface are dug out and sifted, the golden flood-time of the period has passed—not, however, before it has served the purposes of Providence in providing for a great augmenting population, and in converting wild tracts into flourishing hives of human industry.

Passing from the finding of gold to the change which its abundance has already produced, it is pleasing to observe the rapid advance which, under the admirable system of police and protection to property organized by its Governor Sir Charles Fitzroy, the great colony of New South Wales has undergone, and how about a million sterling is realized from the gold fund for the purposes of Government. A similar progress, and under more difficult circumstances, has been made by Governor La Trobe in Victoria, and it requires no prophetic vision to anticipate that, as our country has given to North America its masters, so will she be the founder of another great people of her own lineage and laws, which will extend themselves northwards to the warmer climes of the vast continent of Australia. There will Englishmen find their advantage, not merely by digging for gold

(which will, however, I doubt not, be found, at intervals, in greater or lesser quantities along the western and northern flank of the chief watershed), but in the cultivation of all those natural productions which such climates and soils will afford.

Already I learn that, in a district not more than 100 miles to the north of Sydney, wines of good quality are produced; and there is no reason to doubt that still farther to the north, cotton and the various plants of the East may very profitably be grown.* With such capabilities before them active speculators will therefore always be found to draw out wealth from that best of all mines, the rich cultivable soil.

And here I have true pleasure in referring to the 'Australia' of Mr. Montgomery Martin, as a publication of very great merit, for its well-digested contents illustrative of the history, topography, and great natural resources of this vast region. The able manner in which our associate has treated the subject of emigration ought to dispel any alarm created by the present flow of our countrymen to the diggings.

The colonies of New South Wales, Victoria, Adelaide and Perth, are flourishing and progressing so rapidly, that as geographers we are now led to speculate on the approaching solution of one of the most curious of all the problems which can interest this country—the true condition of the interior of this vast continent. The noble efforts of Mitchell, Sturt, Eyre, Kennedy, and others, in overcoming the most extraordinary difficulties, have, indeed, carried inquiry to vast distances beyond our own frontiers. Alas! the chivalrous Leichhardt, after greatly extending our knowledge of the earth's surface, has too probably fallen a victim to his bold endeavour to penetrate across a portion of the continent. But no sooner is this calamity brought under our consideration,† than another stout-hearted volunteer has presented himself, in the

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* After this was written, both cotton and silk, the produce of these tracts, were laid on the table by Mr. Stuart Donaldson, at the anniversary meeting of the Society.

† From information recently communicated to me by Mr. G. F. Leslie, a proprietor in the extreme northern British district of Darling Downs, from which Leichhardt started, in 1848, to traverse the continent, it would appear that some hopes are entertained that the adventurous traveller may still be heard of. His project, when he proceeded westward from Darling Downs, was to keep to the banks of the Victoria, as far as the course of that stream to the N.W. Leichhardt's last words were, in taking leave of the colonists, "Do not despair of me for four years." Among his followers was an adroit Scotchman, Donald Stuart, who, formerly a convict, had proved most trustworthy, and had a thorough acquaintance with the natives, among whom he had passed many years, and with whose habits he was so familiar, that he could obtain a livelihood where other civilized men would die. Such a companion, it is supposed, could scarcely be lost; and if even he and Leichhardt had been murdered by the blacks, it is believed that some of the oxen, mules, or horses of the expedition would have found their way back to their homes.

person of Mr. Ernest Haug.* Seeing that the great obstacle to his successful passage across this continent is the want of water, this traveller first proposed to us the employment of camels or dromedaries, which might be imported at no great cost from India—a plan to which I called your attention in the year 1845, as having been then suggested by our member Mr. Gowen.

Other persons well acquainted with Australia, including Dr. Blundell, who has addressed a sensible letter to me on the subject, and Mr. Kent, approve rather of bullocks and mules as presenting more effective means of transport through the thick and thorny bush. They also think that no successful effort towards an exploration of the interior can be attempted from the shores of Western Australia. This, indeed, has already been rendered manifest by the report of Mr. A. C. Gregory, the Assistant-Surveyor at Perth, which explains the ineffectual efforts of himself, Capt. Sanford, and party, to penetrate through the thickets of acacia on the banks of the Murchison river, in S. lat. 27½, where they could find no fresh water for considerable distances on either side of its banks. Now, as the last surveys of that undaunted traveller Sturt have taught us, that equally in proceeding from the south, a dry, saline desert is reached, in which all rivers are absorbed or evaporated, so we can reasonably look to the east and north sides only of the continent, as affording great unexplored breadths of lands which may prove useful to future generations. Of the eastern side, or the seat of our great settlements, we already know much, but of the north we are little more informed than when Grey and Lushington pushed their gallant adventure up the fertile banks of the Glenelg, or when Wickham and Stokes ascended the noble Victoria for some distance, and laid down its soundings. Nor do we yet know much more of the head of the Gulf of Carpentaria than was ascertained by the same able surveyors, as recorded in the work of Captain Stokes. I enjoy the conviction, however, in common with many geographers, that, despite the warm climate, both these localities are destined for future settlements. Whether, therefore, our Government may or may not approve a search from Cambridge Gulf along the Victoria, in which Mr. Haug and the explorers may reach the watershed, and afterwards pass to the head of the Gulf of Carpentaria, we can scarcely doubt that a noble bay which advances 500 miles into this continent, will, sooner or later, become the great line of intercourse between our Australian and Indian dominions. For here it must be

* The project of Mr. Haug has been subjected to the examination of a very competent Committee, and, if approved, will be recommended by our Society to the consideration of the Government.

recollected the head of the Gulf of Carpentaria is less than 700 miles distant from our most northern settlers, and that the intervening tracts have been ascertained by Leichhardt to be well adapted to cultivation.

The maps of our Eastern Australian colonies and of Victoria or Melbourne, which are about to be issued to the public by Mr. Arrowsmith, will be a great addition to our acquaintance with these lands, the former being on a scale of 20 miles to the inch; the latter, much more detailed, is on the scale of 8 miles to the inch. Some intelligent colonists have expressed to me their regret that of the vast regions which have been surveyed and chained, so small a portion had yet been published. They think that in these days of rapid colonization, and when so redundant a population is attracted to Australia, they might be made acquainted with the *outlines* of the geography of the yet unsettled regions which have been obtained through the successful explorations and skill of the Surveyor-General, Sir T. Mitchell, and his associates. For although not presenting so perfect a facies of physical geography as the beautiful map by the same authorities of the colonized parts known under the name of the Map of the 19 Counties, such outlines would be useful approximations to truth, by which the vast interior tracts watered by the affluents of the Darling and Murray rivers, might be delineated on a general scale.

No region of the earth presents a greater geographical problem to solve than Australia, in the apparent termination in the interior of so many of her vast rivers—some of which are of great breadth and depth, even near their sources in the eastern Cordillera, and end in being evaporated in saline western deserts of little altitude. The restless settler, forcing onwards wherever fine herbage leads him, will, it is true, eventually find his way to the very limits of productive lands. But what we geographers regret is, that so very much of the territory, which lies between such distant outposts and the regularly settled countries, has not yet been inserted on any map; and I therefore hope that by some means or other all the knowledge acquired with so much labour by our distinguished associate Mitchell, will soon be made public.

Great Circle Sailing.—Before we consider some additions which have been made to our acquaintance with hydrography and the currents of the ocean, the collateral subject of what has been called "Great Circle Sailing" may naturally be spoken of. To geographers it seems surprising that there should be any novelty in the navigator being counselled to steer by a path which follows the real form of the globe, in preference to the necessarily faulty direction which is given to him by a course laid down on a Mercator's projection, every degree of which, as

it recedes from the Equator, becomes more and more erroneous as it approaches towards the Poles. In truth, all really scientific seamen, from the time of Columbus, must have more or less attended to this rational system of sailing, about which so much has recently been said; and I should not have called your attention to it, if it were not for a very ingenious invention of Mr. Moore, termed by him the "Great-Circle Indicator," which is designed to obviate the elaborate calculations beyond the reach of many practical seamen, and by which any of them may at once decide on their real course. It is for nautical authorities to pronounce on the adaptation of this clever instrument to its ends, and to say whether this contrivance will best answer the purpose for which a set of diagrams have also been prepared by Mr. Russell. If the latter would be less costly, it is right to state that Mr. Moore is of opinion that, if largely purchased, his brass Indicator might be sold at no greater charge than 20*l*.

The Ocean—its Currents, Tides, Depth, and the Outlines of its Bottom.

When, a short time ago, I was conversing upon comparative or ancient geography with a friend whose mind ranges over all subjects, from the epic to the abstrusest mathematical problem, I was reminded by him that those who are acquainted with the writings of the ancients would see with admiration how often a piece of knowledge, or a thought belonging to those by-gone days, emerges with an applicability to our new geographical views which is truly astounding. Take, says he, the Homeric view of the ocean; it was an ocean, and yet an *ocean stream*. It covered the immeasurable earth, and yet it ran round the boundaries of all known lands. Thus, the most learned of our popular poets has also spoken of the region

> 'Where jealous Ocean, that old river, winds
> His far extended arms, till with deep fall
> Half his waste flood the large Atlantique fills.'

When the poet goes on to pour his flood into

> 'Slow, unfathom'd Stygian pool,'

we have only to vary the reading, as Dr. Whewell suggests, to

> 'Half the broad Pacific's tideless pool.' *

* Though there are many tides in the Pacific, this idea of a tideless pool may be correctly applied to the central Pacific around Tahiti. Geographers will do well to refer to the Appendix to Captain FitzRoy's second volume of the Surveying Voyages of the Adventure and Beagle, to see the value attached by that successful navigator to the essays of Dr. Whewell, and also to appreciate the importance of the views of so experienced and scientific a seaman.

But the point for us is not merely to occupy ourselves with finding that the ocean, as the ancients imagined, does "wind its extended arms" like those of a river. However we may regard this as a flight of imagination, or admire it as the foreknowledge of our ancestors, our duty is more stern, and we must pass from the myth, to ascertain what arms this jealous ocean has, how far they extend, where they wind, and where they end in "steep fall;" which last words, brought down to our geographical prose, means merely an accelerated current. Now, although we have had many admirable contributions to answer these questions, and above all comparison those of the illustrious Rennell, who led the way in all these inquiries, there still remained a vast deal to be accomplished. The memoir of Mr. Findlay, recently read before the Society, illustrated as it was by a series of admirably constructed large charts, in which all the cold or polar currents were marked in a blue colour, and the warm currents in a red tint, is certainly the most complete general view, which has been taken in our day of this grand subject—a full and accurate acquaintance with which is of such importance in the intercourse between distant nations. In these valuable documents, and particularly in the work of the same author to which I called your attention last year, we not only see the extent of our present knowledge as to the nature and distinction of upper and under currents, but also the desiderata which remain to be filled up. I cannot here, indeed, attempt to convey to you an adequate view of Mr. Findlay's labours of compilation and deduction, and must restrict myself to saying that, taking into account the known currents of the Atlantic and Pacific, and having regard to additional observations, he reduces the motions of each of the two oceans to systems of revolving, re-entering currents; one such circle, or orbit, existing in each case to the N. and S. of the equator.

The currents of the ocean are so complex and numerous, that it is not to be expected we can obtain all the requisite materials to form a correct view from ordinary navigators, who are occupied in trade and commerce. And this brings me back to a point on which I dwelt last year:—or an expedition "ad hoc," and entirely devoted to the survey of the *Tides of the Ocean*. Such an expedition, connected as it must be with a special attention to the currents, would, I repeat, be truly worthy of this maritime nation, and all geographers would rejoice if its conduct were confided to our associate Captain FitzRoy, whose tried capacity as a naval surveyor and sound nautical accomplishments particularly qualify him for such an employment. For we must recollect, that in addition to the researches of Sir John Lub-

bock in this country, and those of Professor Bache in the United States, the able, consecutive, and elaborate investigations of Dr. Whewell, founded on real data, have led far towards the establishment of definite laws respecting the tides. It is, therefore, much to be desired that the naval authorities of Great Britain, honouring these skilful gratuitous labours, should, without delay, accede to the prayer of the British Association, and send out such an expedition as is here proposed—one which would enable Dr. Whewell to complete a generalization worthy of this age of inquiry, and of the greatest utility to navigation.

In the meantime it is a subject of congratulation, that a Peer of the realm distinguished for his acquirements in astronomical science, sustaining the same objects for which we are contending in common with the British Association and the Royal Society, should have brought this important subject before Parliament, directing specially the attention of the Upper House to the very great importance of such observations and generalizations as those of Lieut. Maury of the United States Navy. This meritorious officer, some of whose researches were adverted to by my predecessor, has recently issued a circular which calls for the co-operation of the principal maritime nations in collecting materials for wind and current charts. The prayer of the British Association for the Advancement of Science, and of the Royal Society, that a more extended and systematic direction be given to meteorological observations at sea, as prepared by Lieut. Maury, will, I trust, meet with favour in the eyes of the British Government. The Royal Society says truly that, short as the time is that the system has been in operation, the results to which it has led are of very great importance to the interests of navigation and commerce; and it is earnestly to be hoped that the system of co-operative observation may be zealously promoted. In short, when Lord Wrottesley explained in Parliament what enormous spaces of the ocean were still blanks as to any records of the winds, or of the currents and temperatures of the sea, the words which he added will find a response in the breasts of all whom I now address:—"That these blank spaces are a reproach to the civilization of the present age; that it is our duty not to rest satisfied until we know all that can be known about the globe we inhabit that can be rendered in any way profitable to our common species; and that, therefore, the principal maritime nations should share the labour of exploring these vacant spaces."

Our neighbours, the French,* have, indeed, shown their desire to promote useful surveys of distant seas by the addition they have recently made to our knowledge of the hydrography of the Chinese seas, resulting from the researches of the 'Capricieuse' corvette, under the command of Captain Roquemaurel, who has trigonometrically surveyed the eastern coast of Corea and Chinese Tartary for an extent of 130 leagues. One of the results is the ascertainment of an excellent port in the Golfe d'Anville, nearly in the same parallel as the strait of Matsmai, from which it is about 130 leagues distant; parallels in which it is suggested some profitable whale-fishing grounds may also be met with.

As the phenomena of tides, currents, winds, and the condition of the atmosphere and ocean are in great measure dependent on the outline of the solid portion of the earth, so has this year brought with it the most remarkable hydrographical observation of modern times in the detection of an abyss in the ocean said to be nearly double the depth of any of which we previously had a conception.

Hitherto, indeed, it had been the prevalent belief (an opinion supported by La Place himself), that the depressions of the crust beneath the ocean were probably of about the same extent as the elevations above the sea. Some observations of our scientific associate Captain Denham, R.N., have, however, gone far to modify if not to set aside this hypothesis. By soundings† in the ocean, mid-way between the Cape of Good Hope and Tristan d'Acunha, he has concluded, after several times dropping the plummet and by finding the line always stop at the same point, that the sea has there the enormous depth of 7,706 fathoms, or double the height of Chimborazo, the giant of the Andes.

It is, also, a triumph of nautical skill and perseverance that the 'Herald,' and her companion the 'Torch' steamer, should have been enabled to lie at anchor more than three weeks on the comparatively shallower banks in the middle of the wide Atlantic ocean, such a position having greatly astonished those mariners whose course happened to cross these new and unheard of anchoring grounds. When so stationed, Captain Denham further ascertained, by sending down thermometers,

* Since our last anniversary the Meteorological Society of Paris has been established, and is now organized in so satisfactory a manner, that I have joined it myself, and trust that many of my countrymen may do so likewise.

† The soundings were made with peculiar lines given to him by Commodore McKeever, of the United States Navy. But I must state that some naval surveyors are of opinion, that the results may have been more or less deceptive, in consequence of the line not lying in a straight direction between the ship and the plummet, whether by the vessel drifting during so long an operation or by the influence of currents and other causes.

that, whilst the surface-water was at 90°, the cold never exceeded 40° at any depths which were sounded. In addition to important magnetical observations, he has excited great interest amongst geologists by proving, that, within one cast of the lead, coral reefs rise suddenly like a wall, from *no bottom* at 200 fathoms to 19 fathoms from the surface; thus illustrating one of the phenomena on which Mr. C. Darwin has thrown so much light.

In looking at the statement of Captain Denham, and at the vast number of desiderata that remain to be inquired into, it is not, therefore, too much to affirm, that until our submarine knowledge shall have been vastly more extended than it is—until, in short, we know as much of the earth beneath the waters as of that which is above them—we are wanting in several of the most essential elements to explain the proximate causes of the deflection of the great oceanic currents to which we have been adverting, as well as of the origin of many climatal peculiarities.

The geologist, meteorologist, and geographer, are indeed each of them equally interested in the determination of grand problems like these, which will teach us the forms of the submerged lands around which run the various streams delineated in the maps of Mr. Findlay. Such, for example, as that which, with its superjacent floating masses of "Sargasso," or sea-weed, circles in the North Atlantic, or the great whaling grounds of the North Pacific, around which the North Equatorial and Japanese currents flow: or, again, that mass between New Zealand and Australia which is encircled by the Australian current.

In this last instance the geologist again steps in to help to solve the problem. The discovery of the enormous bird, the Dinornis, in the comparatively small tract of New Zealand, has naturally led him to suppose that there was once a much larger adjacent mass of land to provide for the sustenance of such huge creatures; and hence it is a fair inference, that the nucleus, around which the Australian current runs, is the central and higher portion of what was a large continent once united with New Zealand.*

In the meantime, passing from such theoretical views, I seize on the one great submarine phenomenon indicated by Captain Denham, to assure you that however it may be modified, I view it as of singular

* The same reasoning may be applied to the Island of Madagascar, where eggs of birds have been found, which contain the substance of 240 hen's eggs. This isle may be the remnant of a former vast eastern continent now submerged. See Professor Edward Forbes's proofs of the existence of such ancient continents, derived from the present insulation of certain groups of plants and animals.—*Memoirs Geol. Surv.*, vol. i.

importance in enabling naturalists to account for the marked separation of the tribes of marine beings which at present exist in regions widely separated from each other. For, vast depths are to many inhabitants of the sea (including all the mollusca) what great and snowy heights are to the animals of the land—perfectly impassable barriers. Now, whilst we have, in the profundity of parts of the present ocean, a distinct reason for the separation of aquatic races in our times, the near approach, on the contrary, to a general and uniform distribution of marine mollusca in primeval periods, as registered in the ancient sea bottoms, which have been raised to form our present continents, compels me to believe, that the earlier geographical outlines of our planet were infinitely more simple than the present. In other words, that the oceans were then broader on the whole, the lands of less altitude, and the cavities in the sea bottom by no means so deep as those of our actual highly diversified outlines. For, had such very varied outlines prevailed in primeval periods, most unquestionably the same land-plants which are found in the old coal formation could not have lived from Spitzbergen and the Polar regions to temperate and even warm latitudes, and in nearly all longitudes; nor could the same tribes, and often the small species of shells and other animals, have inhabited the most distant seas at the same period.

It is this varied outline, as brought about after many revolutions and changes of the crust of the globe, which presents to the meteorologist that mass of complicated problems, so few of which have yet been sufficiently solved to enable us to arrive at definite laws respecting weather, or the causes of its seemingly capricious changes. But still, notwithstanding all its variations, there is a mean distribution of heat and cold, which restricts certain groups of creatures to each continent and sea; and the more we can approach to a correct delineation of these zones beneath the waters, as well as those above them, and comprehend the nature of all tides and currents, the more perfectly shall we attain some of the highest aims of the physical geographer.

Conclusion.

If the discourse which I have now read to you has fallen short of that which I delivered at the last anniversary, in analyzing the recent labours of geographers, you will, I trust, extend to me the same indulgence which you granted on a former occasion. In the year 1845, when I took leave of you after a former term of office, I pleaded incessant occupation in preparing a large work on Russia and the Ural Mountains as an apology for all defects. After

an interval of eight years, I again say farewell with a similar plea; for during the past year I have been endeavouring to put my various geological writings into order and to produce a condensed view of the history of the older rocks. That work, which but for my occupation with this discourse would now have been published, may at all events have a bearing on geography. It may induçe some of my associates to ponder upon the difference between the outlines of the earth during such early periods and those which now prevail, and to understand how, under dissimilar physical conditions, races of animals, very different from those of the present era, were the primeval inhabitants of our planet.

Yet despite of all the labours of geographers, geologists, and naturalists, we have only to cast our eyes over the surface of the globe to see how vast is the unknown which remains to occupy the intellect and rouse the energies of geographers for ages yet unborn. We are, indeed, only approaching to the delineation of other and vaster fields, in completing the surveys of which our successors will, perchance, smile as much at our ignorance, as our contemporaries may sneer at the geography of the ancients. But the true inductive philosopher stands aloof from such criticism. He knows that every advance must depend on new observations, and that each successive generation can but establish some additional stepping-stones, whereby man may reach nearer to those limits which must ever separate him from Omniscience.

In the mean time, as one among the zealous votaries in search of new phenomena on the surface of our planet, I have a true satisfaction in reflecting, that I have taken an active part in the establishment and progress of a Society like this, upon the continuance of whose welfare the cause of sound geography mainly depends. I have, indeed, been delighted to learn at the close of my Presidency, that the prayer to have suitable apartments allotted to us, which has been so long urged, and was so graciously entertained by our Royal Vice-Patron, has met with the sincere good will of the present accomplished Premier—one of our original members, and for many years the President of a learned body whose pursuits are closely connected with our own.

As her Majesty's Government fully admits, that no scientific body can have stronger claims to such a consideration, and has expressed a wish to befriend us, I have a confident expectation that in the next autumn we shall assemble in halls of our own, though perhaps they may be granted to us for a term only, and until we can find a fitting resting-place in a great national Institute, in which the science of Britain will be for the first time united.

You were doubtless also well pleased to recognize, in the notice of a motion in the House of Commons given by the patriotic leader of British economists, the expression of an honest desire to promote, by every means in his power, the objects for which we are associated. Does not, indeed, the unprecedented augmentation of our members during the last year, including as it does the names of many distinguished statesmen of all shades in politics, sufficiently testify, that whilst we pursue geography for the love of the science, we at the same time are doing real, public service, and are laying the foundations of new and great commercial interests for our country?

The very name of my successor is an earnest of this feeling; for in the Earl of Ellesmere you have selected a nobleman who, succeeding to large hereditary estates, has attained the more durable distinctions of successfully communicating knowledge by his pen, and of aiding its diffusion among all classes with a liberal hand. To him I confide your interests, in the hope that he may enjoy as much true satisfaction as I have had in presiding over you; and in the full conviction, that he will record with an eloquence to which I can lay no claim, the fresh triumphs of geographers in all parts of the world.

PAPERS READ

BEFORE THE

ROYAL GEOGRAPHICAL SOCIETY.

I.—*Physical Geography of Western Tibet.* By Captain H. Strachey, of the Bengal Army, F.R.G.S. (*Gold Medallist.*)

Read November 22, 1853.

Tibet. — As my purpose in the following pages is to confine myself generally, if not rigorously, to the result of my own observations and inquiries, I shall say nothing more of Tibet in general than may serve as a starting point to these, and explain the names and allusions which must often occur in them.

Tibet is an extraneous appellation unknown to the inhabitants of the country we so designate, and apparently adopted by Europeans through the medium of the Asiatic Türks and Persians, whose *Tbt* some English writers have improved into *Thibet*, and French and Germans into *Tubet.* I cannot set aside a word which long prescription has so completely naturalized in our language, but in using it I shall retain the simplest form and the nearest to the Turkish original. The true autochthonous name of our Tibet is *Bodyul*, which would be properly rendered into English *Bodeland:* it is also called simply *Bod.* The *Bhot* (and *Bhotiya*) of the Indians is no doubt derived from this word, although the Tibetans have stories otherwise accounting for the Indian name. The *Hun* and *Hundes* of the Hill Indians are about equivalent to our *Tartars* and *Tartary;* and where these are used, the more correct terms are improperly restricted to those Tibetan stragglers who have crossed the Indian passes, and applied to the Himalayan regions in which they have taken up their abode.

The Tibetans, no less than other nations, greatly corrupt the indigenous names, or invent spurious names of their own, for the foreign countries nearest or best known to them; and the geographer should understand these. *Gyanak*, *i. e.* the *Great Black*, is *China*, so called from the predominance of black (or dark blue) in the dress of the Chinese people: but a Chinaman is called simply *Gyami*, *i. e. Great Man*, and in Tibetan estimation he is pre-eminently such. *Gyagar*, *i. e.* the *Great White*, is *India*, so called from the general dress of the people. *Gyaser*, *i. e.* the

Great Yellow, is *Russia;* whether so called from the supposed prevalence of auburn hair or yellow clothing among the Russian people, I know not. *Filing* is a corruption of the Persian and Turkish *Farang,* denoting *Europe: Gyafiling, i. e. Great Frankland,* though properly signifying *Europe,* is commonly applied to *British India. Horyul* is *Turkland*—in the language of its own inhabitants *Turkistan;* and particularly the South-eastern region next to Tibet, or the Kingdom of Kashghar, which some European geographers have called—most improperly—*Little Bucharia. Sok-yul* is the land of the *Sokpo,* whom Europeans call *Mongol,* and the Turks *Kilmak* (both no doubt incorrect substitutions of a part for the whole). Such terms as *Khamsok* and *Horsok* are sometimes applied to the countries between East Tibet, S.E. Turkistan, and Mongolia; denoting a mixture, whether real or imaginary, of Tibetans and Mongols, and of Turks and Mongols, where those countries border upon each other.

The Indian Provinces next adjoining to Tibet are *Ashong, i. e. Acham,* or *Assam. Monyul,* the whole of the *Indian Himalaya,* especially the *Sub-Himalaya* inhabited by *Mon, i. e. Hill Indians. Lhopato, Lho-duk,* or *Lho-mon,* the *Bhotant* of Bengal, or *Bootan* of the English. Its capital *bKrashismchhosdzong,* or pronounceably *Tashichuzong, i. e.* the *August City of Religion* (improved by the English to *Tassisudon* and the like). *Demojongs, i. e.* the *Goodly Region,* the *Shikim, Shikimpati,* or *Sikkim,* of Indians and English: the British cantonment in its lower part is *rDorjegling* or *Dorjeling* (corrupted to *Darjeeling* and the like), a name equivalent to *Vajrapura,* or in plain Saxon *Thunderbolton* (otherwise the *Place of the Heavenly Sceptre,* or of the *Precious Stone* or *Diamond*): *Kangschan hJing, i. e.* the Icy Mass, is the great snowy mountain on the N. border of this province, famous as the highest measured peak on the globe. *Palbo* is *Naipal; Kyunam, Kumaon; Galdiya, Garhwal; Chongsa, Himalayan Garhwal; Kunu* is the District of *Knor, Kanor, Kanoring, Kanaur, Kunawar,* &c.; *Nyungti, Kullu; Garzha, Lahaul. Panga* of *Himalayan Chamba, Paldar* and *Maru-Wardwan* of Himalayan *Kishtwar,* are called by their native names. *Kacheyul* (vulgo *Kachul*) is *Kashmir.*

The only part of Tibet with which the English have any direct acquaintance is that which borders upon the north-eastern confines of British India. This region extending from the mountain gorge of the *Brahmaputra* to that of the Indus, is probably little more than the western half of all Bodeland; for the eastern region extends to the western frontier of China, and to a greater breadth than the western, and the Tibetans themselves designate the latter sometimes *Bodchan, i. e.* Great Tibet, but its proper name is *Kham* or *Khamyul;* and I have no further concern with it for the

present. For the exploration of East Tibet we are indebted to the French missionaries Messrs. Huc and Gabet, who, in 1846-7, traversed the whole breadth of *Khamsok* on their way from North China to the capital of Central Tibet, and of *Khamyul* on their return to Central China; and Mr. Huc's well known narrative of this most adventurous journey contains, I believe, the sole direct European information regarding those parts of Tibet.

The region known to us as lying behind the Indian *Himalaya* is a belt of high mountainous table land, narrow compared with its length, and (to the best of our imperfect knowledge) subsiding, on its N.E. border, into the plains and sandy deserts of *Turkistan* and *Khamsok*. This part of Tibet is called *Bod, i. e. Tibet proper,* or Central Tibet, at its E. end, and *Nari* at its N.W., the former division being the shorter of the two, but probably the broader, and certainly the more populous and civilized.

The line separating *Bod* from *Nari* may be taken approximately as a continuation of that dividing the E. end of *Naipal* from the British dependency, or annexure, of *Demojong*, which latter is also the demarcation of Indian races from those of the Tibetan family on the S. slope of the *Himalaya* (or more strictly, of the predominance of those races in the *Sub-Himalaya*). The division of *Nari* from *Bod* is partly natural, inasmuch as the elevation of the country becomes inimical to agriculture and population to the westward, and lower, warmer, more habitable, and more cultivable to the eastward. But there is no great geographical landmark that we know of, nor any ethnical or political separation of the inhabitants.

Bod proper is subdivided into several territories, provinces for extent, though mere districts for population. These are (from E. to W.) *Kongbo, Takpo, dvUs,* and *gTsang;* and perhaps others. *Kongbo* being so warm as to admit the general cultivation of rice, and so moist as to be well wooded with natural forest, may be reckoned with probability to lie about the valley of the *Brahmaputra* immediately before its downward passage to the noxious climate and barbarous people that oppose the ascent of the English explorer from *Ashong*.

In *dvUs*, already elevated into a cold climate, lies the *Gyalsa* (*i.e.* Capital) of all Bodeland, the City of *Lhasa* (*i.e. God's-ground*), the *Rome* of Tibet; which has been rescued from an almost mythical obscurity by the enterprising French travellers above mentioned. Of *Tsang* and its monastic capital *Tashi Lhunpo* (*the August Lump*) the English reader may find a faint, dreamy sketch in the pleasing narrative but vague geography of Turner. These two provinces are often coupled together in Tibetan phraseology under the name of *Utsang* (merely an abbreviated compound of the two names), which may be taken to signify generally *Central Bod*, as distinguished from *Nari* and *Kham*.

Lhopato and *Demojong* being inhabited by Tibetans retaining their own language, manners, and governments (more or less modified by Indian influences), would be included by a Tibetan geographer in a complete account of his own country; but in physical geography they belong rather to India. Regarding the former of these provinces information may be sought in the pages of Turner and Pemberton; and the latter has recently been laid open to the arts and arms of *Dorjeling*.

Nari, or Western Tibet.—*Nari* is divided by the Tibetans into three great provinces, viz., *Mangyul*, *Khorsum*, and *Maryul*. The first of these is nearly conterminous with the present kingdom of *Naipal*, but not extending quite so far to the W. It is probably as broad as that country, or broader, with near an equal area, but not a hundredth part of its natural and political resources, being so elevated, cold, and dry as to support little beyond a scanty population of shepherds with a few small villages in the warmest parts. The chief districts of this province are (reckoning from E. to W.) *Tingri* (*Lawn Mountain*), *Shelkhar* (*Glass Castle*), *Nyanam*, *Khyirong* (*Dog Valley*), *Chamshen Tsuglakang* (containing a Tibetan *University !*), and *Kungtang*, on the southern border; and some of them forming the heads of valleys that enter *Naipal*, and containing agricultural villages: *Zangzang*, *Kyado*, *Semukul*, *Saka*, *Nyugu*, *Tradum* (a monastery), *Troshot*, and *Shamtsang* are in the central part, all high pastoral upland; and the *Dzong*, or seat of local government of the whole province, is at *Saka* (otherwise a mere shepherds' hamlet): *Bong Madma* in the N.W. quarter, also pastoral upland, though belonging geographically to *Mangyul*, is, and has been for many centuries, included in the government of *Nari-Khorsum*. I know little beyond the names and *relative* position of all these places; nor can we expect to learn much of *Nari-Mangyul* whilst *Naipal* itself is debarred to the English traveller.

Nari-Khorsum is that N.W. extremity of the Chinese Empire (but not the westernmost, for *Kashgar* extends to the meridian of *Peshawr*) with which the British have been in contact since they annexed the *Himalayan* provinces between the *Sutluj* and *Kali*; and *Nari-Maryul*, the N.W. extremity of all Tibet, comprising the modern provinces of *Ladak* and *Balti*, already well known by the descriptions of Moorcroft and Mr. Vigne. When I use the term *West Nari*, it may be understood to mean all *Nari-Khorsum* and *Maryul*, to the exclusion of *Mangyul*, and my own explorations are confined to this region.

I leave the Indian confines of Western Tibet to the Indian geographer; and most parts of them, W. of *Naipal*, have been explored and described in detail.

With a small exception, we know very little regarding the

countries that bound it on the N.W. and N.E. In the former direction it seems pretty certain that the great mountainous mass of the Tibetan table-land and Indian *Himalaya* is continued much in the same style till it ends abruptly about the 40th parallel of N. latitude, in the mountains which the Turks call *Bulut Tag* (*i. e. Cloud Mountains*), E. of *Samarkand*, and S. of *Khokand*, in the very centre of Asiatic *Turkistan*. This name is almost as significant of great height as the *Himalaya* (*Abode of Snow*) of the Indians; and the blank in civilized habitation, the separation of empires, and the scanty commercial communication in that quarter, seem to point to the same conclusion; though no actual account of the region that I know of is to be found in any of the published Geographies. The former direction of the chain is perhaps continued beyond the *Bulut Tag* towards the *Aral* Sea, but if so, in mere hillocks compared with the mountains of *Pamir* and *Nari*. In elevation and mass, however, these mountains have a decided continuation, with a very acute change of direction, in the great chain which the Chinese geographers call *Thian-Shan* (*i. e. Celestial Mountains*) projected to the eastward, through the eastern extremity of *Turkistan*. The *Afghan* range, which continues the watershed of the Indian regions to the westward, can only be looked upon as a long spur or branch much inferior in elevation to the main trunk, the high masses of the *Hindu Kush* being as it were the point of articulation.

Mr. Wood's description of *Badakhshan* and *Pamir* presents a remarkable likeness to a province of the Indian *Himalaya* (such as *Kanor*), communicating by a valley gorge (as that of *Tsotso*) with a Tibetan upland (like *Rupshu*). On both the summits we have 15,000 feet lakes embedded in 19,000 feet mountains, with the same zoology of domestic yak and wild sheep; and the *Khirgiz* even is cousin-german to the *Changpa* of *Nari*.

The countries occupying the main mountain mass between *Pamir* and the N.W. extremity of *Maryul* (including *Kafiristan*, *Chitral*, *Yasen*, &c.) have been so completely barred against European research by the barbarism of their inhabitants, that their names even are uncertain, and we know scarce anything of their geography beyond the fact of their being highly mountainous; but the turbulent and predatory character of the people would prove them to be ethnically related to the Afghans rather than the Western Tibetans; and as they exhibit themselves in their national rôle of gang-robbers up to *Gilgit*, on the frontier of *Balti*, I shall consider Tibet to be terminated there by the southward turn of the Indus towards India, and by the lofty spurs of mountain which project to the northern point of the river bight from a Turkish watershed, dividing the north-western extremity of Balti from the non-Tibetan countries of *Nagar*, *Hunz*, *Kanjut*, and *Gilgit*.

E. from this point the northern confines of Tibet are better determined, as far E. as the meridian of 82° or 83°. Native information from the side of India and Tibet (the best of it collected by Moorcroft), coupled with the Chinese geography imparted to Europe by the savans of Paris and Berlin, and the very slender accounts of one or two antique European travellers, assure us that the mountainous table-land descends in that direction, by hilly slopes similar to the *Sub-Himalaya*, to a great plain like that of India, extending indefinitely to the eastward, and inhabited by true Asiatic Turks, of late years under Chinese government. This northern mountain slope is almost uninhabited, and in its upper part naturally very barren from elevation, cold, and excessive dryness of climate; but the plain below is well cultivated by a civilized population, excepting its S.E. quarter, where scarcity of water and abundance of sand convert it into an impracticable desert, apparently the S.W. extremity of the great *Shamo* or *Cobi* of the Chinese geographers.

The Chinese-Turkish provinces lying next to the mountain foot are *Kashgar*, at the N.W. end, in the corner between the *Bulut Tag* and the *Thian Shan; Yarkend*, below *Pamir Kanjut* &c., and *Balti;* and *Khotan*, under *Ladak* and *Nari-Khorsum*. The communications between *Balti* and *Yarkend* are now almost closed by political barbarisms, superadded to natural difficulties, and the only extant intercourse between the Turkish and Tibetan countries confined to one oblique line between *Ladak* and *Yarkend*. The direct passages from *Nari-Khorsum* to *Khotan* are totally unused, but I am well assured of their existence, and in the lower part of the mountain slope lies the fertile and populous district of *Serikia*, through which there was once, according to Moorcroft, a high road from *Gar* to *Khotan*.

From information of my own, as well as from Klaproth's map, I gather that the province of *Khotan* lies further S. than *Yarkend*, and consequently that it can admit of no great expansion of the Tibetan table-land up to the meridian of 82° or 83°; but E. of that my information of the northerly confines of Tibet becomes as vague as our European versions of the Chinese maps; yet it seems certain that the *civilized* regions of *Nari-Mangyul* and *U-Tsang* are still confined to a narrow belt. The inhabitants and travellers of this zone complain of the incursions of a lawless tribe who occupy their northern borders, and are said to call themselves *Rundur*, though by the civilized Tibetans commonly termed *Kyampo*, i. e. *Nomads*, which is vulgarly corrupted into *Khampa*, and so improperly confounds these demi-savages with the peaceful and civilized people of Eastern Tibet. The *Rundur* are said to be essentially Tibetan in their physique and language, but barbarous in dialect and manners, almost independent of the Chinese government in their own haunts, and visiting the civilized regions

on their S. as much for plunder as for trade. The last stragglers of them come as far W. as *Gar* and *Ruduk* of *Nari-Khorsum*, but they chiefly infest the roads between *Nari* and *UTsang*, avoiding the government parties, but robbing private persons, sometimes killing, and even, it is said, *eating* them; the best of them, however, occasionally doing a little honest trade in shepherds' products. They dwell in tents only, roving much from place to place, and live exclusively on the flesh and milk either of their domestic cattle—horses, yak, and goats and sheep—or of the Tibetan antelope (*Tsos*), which they catch in snares or pitfalls (fire-arms being scarce among them); and corn or any other vegetable food is hardly known to them—they are, in short, complete *Tartars*. The country of the *Rundur* cannot be over accessible to the civilized Tibetans themselves, and they certainly know very little about it, although the Chinese geographers have pretty well sprinkled it with lakes, rivers, mountains, and names. For my own part I exhaust my knowledge of its natural geography by saying that it is elevated and mountainous, and apparently the northern part of the Tibetan table-land, bounded on its N. by the S.W. end of the Great Desert, which itself may be very elevated here, as the Russians have found some parts of it at the N.W. end. This desert is well known to extend as far as *Khotan*, and completely hems in that province on the E., leaving its only external communications towards the plain of *Yarkend* or the mountains of *Nari*.

General River System.—*Nari-Mangyul* is separated from *Nari-Khorsum* by a natural landmark, viz. a transverse mountain ridge running from the N. face of the Indian watershed, more or less to the N., across the breadth of the central upland, and itself constituting a great watershed that divides all *Nari* and *UTsang* into two main basins of drainage. The major axes of both these lie parallel to the longer direction of the table-land, till they attain the further extremities of *Bod* and *Nari* respectively, where they become deeply sunk, and turn rather abruptly through the *Himalaya* to enter the plains of India.

The river that carries the drainage of *Nari-Mangyul* and *UTsang* to the south-eastward is called by the Tibetans the *rTachok Tsangspo*, i. e. *Horse River*. The best of my Ladak informants could not assure me positively of its course below *Lhasa*, but assented fully to its identification with the main trunk of the *Brahmaputra* river, as asserted (and all but established) by the geographers of Bengal. The river which drains the greater part of *West Nari* to the north-westward, called by the Tibetans *Senge-Tsangspo*, i. e. *Lion River*, is now well established (by the explorations of Mr. Vigne, and subsequent surveys of Lieut. R. Young) as the chief source of the *Indus*—a fact which English geographers have had to rediscover for themselves within the

last half century, though I find it distinctly stated in a book (and that not professing geography) written by a Tibetan monk 250 years ago.

But the *Indus* is not the only river of *West Nari;* all the S. part of *Nari-Khorsum*, and a small eastern corner of *Maryul,* are drained by the heads of the Indian *Satadru*, v. *Sutluj*, the chief of which, called by the Tibetans *Langchen Tsangspo*, i. e. *Elephant River*, originates in the southern part of the transverse watershed that divides *Nari-Khorsum* from *Mangyul* (the heads of the *Indus* occupying its northern part), and breaks through the *Indian Himalaya* in Upper *Kanor*.

If we conceive the whole breadth of Asia towards its medial meridian to be divided into three great zones, approximately parallel to the equator, of which the northernmost or Siberian drains into the Polar Seas, the central or Turkish into inland seas or sandy deserts, and the southern or Indian into the Indian Ocean—the western half of Tibet will occupy the very northernmost border of the last region, forming in this respect an easterly continuation of *Afghanistan*, and the great S. Asiatic watershed will lie along the northernmost confines of the Tibetan table-land, dividing Tibetan from Turkish waters, and altogether behind the *Indian Himalaya*. The western prolongation of this watershed has been repeatedly crossed by English travellers in the hills of *Afghanistan*, but in all Tibet only just touched at a single point of *Maryul;* Dr. Thompson having in the summer of 1848 crested the *Karakorum* Pass, which divides a northern affluent of the Indus from a stream pretty well known to join the river of *Yarkend*, and Mr. Vigne in *Khapalu* of *Balti*, and myself in *Nubra* of *Ladak*, reached terminal glaciers, supposed to be upon the S. slope of the same watershed; but with these exceptions the Tibetan line is unexplored, and known only by meagre native reports.

Persons not familiar with mountain geography are apt to consider a main watershed as identical with a high mountain range, and the idea is of course founded on natural facts; but in detail the exceptions almost exceed the rule, and the chief watersheds will often be found to follow the lowest of the ridges—mere valleys even—and the channels of drainage to cross the highest; nor will this be thought strange if we regard the depth and number of the fissures that intersect these mountains, often directly transverse to the main lines of elevation, and the sufficiency of the slightest slopes to establish a flow of water no less positive than the steepest.

The line that I have termed the Indian watershed is not the crest of the great *Himalaya* as seen by the Indian observer, but a succession of valley heads much depressed, and penetrating that mass to such a depth (in *Kumaon* and *Garhwal*, according to my brother, 35 miles) that the passes from India to Tibet are never visible from any station fairly S. of the perpetual snow. These

recesses are of various depths; the smaller and more numerous discharge the shorter sources of the Indian rivers, such as the *Vet* of *Kashmir*, the *Chandra-Bhaga* of the *Panjab Himalaya*, the *Jamna* and *Ganges* of *Hindostan*, and no doubt many tributaries of the latter flowing from *Naipal* to *Bengal;* but a few of them are so great as to form an absolute break through the outermost ranges of the snowy mountains, and make the sources of some of the Indian rivers absolutely Tibetan or *Trans-Himalayan*, such as the heads of the *Tsotso Sutluj*, the *Karnali Gogra Purang*, or *Mapcha* river (in S.E. *Nari-Khorsum*), one branch of the *Trisul-Gandaki* (the Tibetan *Khyirong*) and the *Aran-Kosi* (?) of *Naipal*. The passage of the *Langchen Sutluj* is intermediate, as it were, between such indentations and the two great penetrating fissures of the *Indus* and *Brahmaputra*. The northern or Turkish watershed of W. Tibet may possibly be indented and depressed in the same style; but we have no data for safe speculation on the subject.

The Tibetan table-land lying between the Indian and Turkish watersheds may be regarded as the flat top of a great embankment, exhibited in all its thickness in the scarp of the *Indian Himalaya;* the summit, though deeply corrugated with valleys and mountains in detail, being in its general relief laid out horizontally at a height little inferior to that of its southern scarp. The highest summits as yet known and measured certainly lie upon the Indian watershed (or even projected beyond it to the southward); and the abundance of large glaciers in the Turkish watershed of *Maryul*, in spite of the very dry climate of that region, with their general absence in the central parts of the table-land, is indicative of greater height in the former; yet very lofty summits are to be met with in all parts of the interior, some of which when measured may perhaps prove equal to the highest peaks of the *Indian Himalaya;* and the passes which must be crossed to get from one Tibetan valley to another, even in the very central axis of drainage, generally equal those by which Tibet is reached from India; so that on the whole, I think the medial depression is but faintly marked in the beds of the main rivers, without much affecting the mean elevation of the mass.

As none of our modern travellers have visited any part of the great transverse watershed that divides the heads of the *rTachok* from those of the *Langchen* and *Senge* rivers, or *Nari-Mangyul* from *Nari-Khorsum*, for any vague idea of its character we are left to our own conjectures and native report. In the former we must not lose sight of the general habitudes of the mountain watersheds above adverted to; but the latter leads us to suppose that the separation of the drainage (in its southern part, at least) is marked by a well-defined mountain ridge articulated to some great *Himalayan* mass, and running some way northward across

the table-land. The high road from *West-Nari* to *U-Tsang* crosses such a ridge by several passes, of which the most frequented is called *Maryum La*, and this in Tibetan statements is commonly reckoned the boundary both natural and political, though essentially but one point in it, as the term *La* means an individual pass, and not a whole mountain range.

From this, north-westward, my geography becomes more definite, and embraces the results of my own personal explorations.

West-Nari in detail.—The general direction of *West-Nari* is S.E. and N.W. in its longest dimension—that is, *Maryum La* lies approximately in E. long. 82½° (or a degree E. from *Manasarowar*), and the southernmost point of *Nari-Khorsum*, on the Indian Himalaya of N.W. *Naipal*, reaches probably to N. lat. 30°. The southward bend of the *Indus*, where it leaves *Balti*, lies near the meridian of 75° E. long., and no part of Tibet seems to extend further W. Its northernmost extension at this end is probably about 36½° N. lat. The direct length of the major axis of this tract is near 600 miles in a straight line drawn from S.E. to N.W.: the undulated line of the Indian watershed, with all its sinuosities, perhaps exceeds 700.

The furthest personal explorations of English travellers at the S.E. end have extended only to the W. shore of *Manasarowar*, about long. 81° 20′ (Moorcroft and Hearsay, 1812; H. Strachey, 1846; J. E. Winterbottom and R. Strachey, 1848), and to the middle of *Purang*, in lat. 30° 15′ (H. Strachey, 1846); but we have obtained a distinct though distant view of the mountains in this quarter as far as E. long. 82°; and native information regarding the remaining corner to the S.E. has been tolerably precise. To the N.W., Mr. Vigne, in 1832, was the first to reach the furthest westing of the Tibetan Indus and of all Tibet, near *Acho* of Lower *Balti*, about E. long. 74° 50′; his furthest northing, in *Shigar* of the same province, was about N. lat. 35° 40′, still something short of the Turkish watershed. The subsequent explorations of Lieut. R. Young, with Messrs. J. E. Winterbottom and the late P. Vans Agnew, in 1847, extended a little further N., viz. to 35° 50′, in the small valley of *Haramosh*, at the north-western extremity of *Balti*. In the adjoining valleys of *Gilgit* the same travellers got as far W. as E. long. 74° 25′, and as far N. as N. lat. 36° 20′, at the latter point reaching a glacier, perhaps of the Turkish watershed; but this district I suppose to lie without the limits of Tibet.

Our knowledge of the breadth of this region is not so precise; for the Turkish watershed has been actually crested at one point only, as already mentioned, viz., by Dr. Thompson, at the *Karakorum*, in 1848. A straight line drawn from that point to the

south-westward, and perpendicular to the longer axis, meets the watershed of *Kashmir*, near the *Zoji La*, and measures more than 143 miles. In my explorations farther E., I reached a point—viz., the E. head of the *Chang-Chenmo* valley—more than 150 miles in the same direction, from the watershed between *sPiti* and *Rupshu*, but without attaining any knowledge of a Turkish watershed. Still E. of this our explorations are narrowed again by the diplomatic cordon of the Chinese, till they end at the points first mentioned, in the S.E. corner of *Nari-Khorsum*, leaving all the north-eastern quarter of that province comparatively unknown: but native reports attest the existence of a large belt of high pastoral uplands, thinly inhabited by Tibetan shepherds, and subject to the government of *Gar*. In Balti, the explorations above mentioned make the probable position of the Turkish watershed only about 100 miles (of direct map distance S.W. and N.E.) from the N.W. extremity of the Indian watershed, between *Hasora* and the *Kishenganga*. On the whole, we may consider the transverse breadth of *West-Nari*, from the Indian to the Turkish watershed, to average 150 miles, being less at its W. end in *Balti*, and more at its E. in *Nari-Khorsum*.

The total area given by these dimensions is 90,000 square miles; but it is impossible to say whether this includes any part of *Bong-Madma*—itself a very extensive district—or excludes the whole of it.

There is no marked natural boundary between *Nari-Khorsum* and *Maryul;* with the exception of one small part, where the present political or diplomatic boundary coincides with a transverse mountain range and a watershed of the *Sutluj* and *Indus*. This boundary approximates to the meridian of 79°; but the S. end of *Nari-Khorsum* projects half a degree further W., and the centre and N. of *Maryul* as much to the E., so that the mean line runs about S.S.W. and N.N.E. It roughly bisects the length of *West-Nari;* but if *Nari-Khorsum* be broader than *Maryul* (as seems probable), the former will contain about 50,000, and the latter 40,000, of the 90,000 square miles above assigned to the joint area.

A natural difference does exist in the general characters of *Nari-Khorsum* and *Maryul*, like that which I supposed to demark *Mangyul* from *U-Tsang;* viz., the greater depression of the valleys in *Maryul* as they approach towards the exit of their drainage by the gorge of the *Indus*, and consequently the greater warmth of their climate and suitability to agriculture; whereas the high and cold uplands, fit for little but pastoral uses, occupy the greater part of *Nari-Khorsum:* but the two characters are somewhat blended in parts, nor separated by any geographical landmarks; and the line of division lies rather to the W. of the diplomatic boundary above noticed, so as to include the eastern parts of

Maryul with *Nari-Khorsum.* More explicit information on this head will follow.

Geographical Subdivisions.—Before describing the geographical details of these countries, I shall state the names and general positions of their principal subdivisions. *mNaris*, commonly *Nari,* signifies the *Clear* or *Pure*, an appellation appropriate enough to the fine air and water of this country. *Khorsum* signifies the *Three Continents*, or circumscribed tracts, into which Tibetan geographers have divided the province: these are—*Ruduk* on the N., *Guge* on the S W., and *Purang* on the S.E. *Ruduk* is said to be encircled by lakes, *Guge* by rocks, and *Purang* by glaciers or snowy mountains; and though somewhat open to criticism in detail, these expressions have a general significance founded on facts of the natural geography. *Ruduk* is traversed, though not encircled, by the largest of all the lakes of *Nari*, and contains others of less note; and the prevailing character of the whole district is a succession of flat lacustrine valleys, similar to those that contain the existing lakes, and often perhaps exhibiting marks of others now extinct, such as the Tibetan peasant can appreciate in the gross as well as the European geographer. If we take the Tibetan word *brak* (v. *tak*) in the same sense as the geologist uses our word *rock*, and with its own particular import of precipitous form, we shall find it fully characteristic of the central parts of *Guge*, where the precipices of conglomerated alluvial earth are unequalled in all *Nari*, and probably in the whole world. In like manner the mountains of *Purang* are actually pre-eminent for snow—a joint consequence of their great elevation, southerly position, and close connexion with the Indian Himalaya.

The *Three Continents* above described do not exactly express the existing political subdivisions of *Nari;* at the present day they add a fourth district, *Gar*, which occupies the central part, and is dignified by the seat of provincial government bearing the same name, which signifies a *Cantonment;* and *Gar* is, in fact, a large encampment of tents, and not a town of houses: *Garoo, Gartokh, Gardok, Gortope*, &c., are Indian and English corruptions of this name. *Namru* is a small subdivision, on the west side of *Gar* proper. *Tashikang*, i. e., *the August Abode*, a monastery giving its name to the district upon the Indus next to the *Ladak* frontier. *Seng*, i. e., *the Lion*, subdivided into *Seng Tot* and *Seng Mat*, i. e., *the Upper* and *the Lower Lion*, is a large district at the head of the Indus, and either gives or takes the name of that river. *Matsa* lies in the unexplored part of *Nari*, at its N.E. end.

Purang is subdivided into four districts; viz., *Purang* proper, the seat of the Tibetan *dZong*, or district government, in the S.W.;

Kangri, *i. e.*, the *Iceberg* or *Glacier*, on the N.W., containing the lake (*Manasarowar*) and mountain (*Kailash*) that form the *Tirthapuri*, i. e. *Fulfilment of Indian Pilgrimage; Horba*, i. e. *Turkey*, extending up to *Maryum La* on the S.E.; and *Bongba*, or *Little Bong*, a political or geographical connexion of the great *Bong-Madma*, on the N.E.

Guge was formerly called *Zhangzhung*, but the latter name is now obsolete. It contains at present two of the Tibetan *dZong*, one enthroned at *Tsaprang* on the *Sutluj*, in *Guge* Central and Proper, and the other at *Daba* in the south-eastern quarter. *Rongchung*, i. e. the *Little Valley* district, lies to the W., on the lower part of the *Sutluj*, and *Chumurti* to the N.W., next *Ladak; Tsotso*, on the extreme W., though now-a-days a political appendage of *Tashikang* and *Chumurti*, under the government of *Gar*, belongs in physical geography rather to *Maryul.*

Ruduk comprises—*Ruduk* Proper, the seat of a *dZong*, upon the *Ladak* frontier, south of the great lake of *Pangong; No* to the N. of it; and *Tsaka*, i. e. *the Salt-field*, an extensive but unexplored tract to the eastward. There may be other subdivisions of this district, but little is known about it.

Maryul signifies in Tibetan *the Low Country*, a term appropriate to the character of its inhabited valleys as contrasted with *Nari-Khorsum;* but the name is now obsolete, and superseded by the modern appellations of *Ladak* and *Balti. Ladak* occupies the larger and south-western portion of the country, which is inhabited mostly by Budhists; and Balti the extreme N.W., of which the population is exclusively Musalman; but there is no definite geographical boundary between the two, and the political division is somewhat complicated. The boundary between the Musalman and Budhist Tibetans crosses *Maryul* about the meridian of 76½° at its S. end, and 77° at the N., leaving perhaps one-third of the whole area, or 13,000 square miles, to the former, and two-thirds of it, or 27,000, to the latter; but some of the Musalman districts were disputed, and others always possessed, by the Budhist Principality, up to the time of the Dogra conquest (1835-42), and the latest boundary of the *Gyalfu* (i. e. *King*) of *Ladak* reached, at its S.E. end, to the meridian of 75¾°, including about 2,500 square miles of the Musalman country in that quarter; so that *Balti* is thus reduced to little more than 10,000 square miles, and *Ladak* extended to near 30,000.

The name of *Ladak* has a local as well as a general sense; belonging originally, and still in particular, to the central district in and about the valley of the *Indus*, and in the middle of which is situated the capital *Le*. The S.E. quarter of this is called *Rong*, which is properly a mere geographical term, denoting a *deep Valley*. *Hanle* occupies the south-eastern extremity of *Ladak*, next to *Nari-Khorsum;* and *Kakzhung*, on the

highest part of the *Ladak Indus*, is geographically the northernmost part of this district; though the Tibetans make it politically an appendage of *Rupshu*, which is a large district in the S. *Tanktse*, in the N.E., includes *Pangong*, so called from the lake of that name, adjoining *Ruduk* of *Nari*. *Nubra* is the north-western district, and *Yarma*, i. e. *Upper Nubra*, a northern subdivision of it. E. of this there is a large tract of savage, uninhabited country, belonging politically to *Shayok* of *Tanktse*, but without any general name of its own, and for want of which it may be called after that place.

Zangskar, i. e. *White Copper*, though politically a province of itself, is geographically part of *Ladak*, in the S.W. quarter. It includes *sTot*, i. e. *Upper*, and *Sham*, i. e. *Lower*, *Zangskar*; *Lungnak*, the *Black Vale*, in the S.E.; and *Kharnak*, the *Black Castle*, which is geographically the N.E. corner of *Zangskar*, though at present politically attached to *Ladak* proper, which adjoins it on the N.

Purik comprises roughly all the Musalman country at the western extremity of *Ladak*, towards *Kashmir* and *Balti*: its chief districts are *Purik* proper, *Suru* or *Suru Kartse*, and *Hembaps*, which last the Kahsmiris improperly call *Dras*, after its chief village.

Besides those above mentioned, there is the district of *sPiti*, including its southern subdivision *sPin*, which belonged politically to *Ladak*, till it was annexed to the hill provinces of British India; and in most of its geographical characters it assimilates with the former country, though in position it projects further to the S.W. than the general run of the Tibetan frontier, and alignes rather with the valleys of the Indian *Himalaya*; the Indian watershed, however, not being easily definable in this quarter. The area of *sPiti* is about 1,500 square miles, lying without the limits above assigned to *Nari-Maryul*, which, if added to *Ladak*, will make the total area of the *Gyalfu's* Principality, as it existed in 1835, fully 30,000 square miles (at which it was estimated by Moorcroft in 1821).

The districts of *Balti* are, I believe, mostly named after their *Khar*, i. e. *Castles*, or seats of local government; but the central district, containing the capital town *sKardo*, is probably *Balti* Proper. The others are—*Chorbat Khapalu* and *Kiris*, in the northern valley, on the E.; *Khartaksho Tolti* and *Parkuta*, on the main *Indus* to the S.E.; *Shigar*, with the subdivisions of *Barsho* and *Braldo*, on the N.W.; *Rongyul* or *Rongdo*, in the valley of the Lower *Indus*, on the W.; and *Hasora* at the westernmost extremity of *Balti*, and of all Tibet. As I have seen nothing of *Balti* myself beyond the small corner of *Chorbat*, and my knowledge of the rest is secondhand, what little I say of it must be taken "cum grano."

I subjoin a classified list of all the Tibetan provinces and districts mentioned in the preceding pages.

- Bod, *or* Bodyul
  - Kham, Khamyul, *or* Bodchen.
  - Bod, *or* U-Tsang
    - Takpo.
    - Kongbo.
    - dvUs, v. U.
    - Tsang.
  - Lho-Pato, *or* Lho-Bruk, &c.
  - Nari
    - Mangyul
      - Zangzang.
      - Kyado.
      - Semukul.
      - Saka.
      - Nyugu.
      - Tradum.
      - Troshot.
      - Shamtsang.
      - Tingri.
      - Shelkhar.
      - Nyanam.
      - Khyirong.
      - Chamshen-Tsuglakang.
      - Kungtang.
    - Nari-Khorsum
      - Bong-Madma.
      - Purang
        - Bongba.
        - Horba.
        - Kangri.
        - Purang.
      - Gar. .
        - Seng
          - S. Tot.
          - S. Mat.
        - Gar. Namru.
        - Tashikang.
      - Matsa.
      - Ruduk
        - Tsaka.
        - Ruduk.
        - No.
      - Guge .
        - Daba.
        - Guge. Tsaprang.
        - Rongchung.
        - Chumurti.
      - Tsotso.
    - Maryul . . .
      - Ladak
        - Hanle.
          - Kakzhung.
        - Rupshu.
        - Rong.
        - Tanktse. Pangong.
          - Shayok.
        - Nubra. Yarma N.
        - Ladak. Le.
          - Kharnak.
        - Zangskar
          - Zangskar
            - Sham-Z.
            - sTot-Z.
          - Lungnak.
        - sPiti. sPin.
        - Purik
          - Purik.
          - Suru. Kartse.
          - Hembaps.
      - Balti .
        - Chorbat.
        - Khapalu.
        - Kiris.
        - Khartaksho.
        - Tolti.
        - Parkuta.
        - Balti. sKardo.
        - Shigar
          - Barsho.
          - Braldo.
        - Rongyul *or* Rongdo.
        - Hasora.

The names above given are *proper names*, of fanciful or trivial meaning when they have any. But the Tibetan geographers have also some purely natural divisions of their country. They divide the breadth of all *Nari* and *U-Tsang* into three zones, each extending along the whole length, viz., the *Lhogyut*, i. e. *South-lands*, which occupy the third next to the *Indian Himalaya*, communicating by passes into *Monyul*, and sometimes penetrated by the heads of Indian rivers; the *Zhunglam*, i. e. the *Mid-way*, or central zone, which is traversed longitudinally both by the main axis of drainage and by the principal line of communication between the several provinces of W. Tibet; and the *Changyut*, i. e. *North-lands*, which occupy the northern zone towards *Turkistan* and the *Rundur* country.

Each of the chief provinces has its share of all three zones; reckoning from N.W. to S.E., the *Changyut* will comprise *Shigar*, *Kiris*, *Khapalu*, and *Chorbat*, of *Balti; Nubra*, *Shayok*, *Tanktse*, and *Pangong* of *Ladak; Ruduk*, *Tsaka*, and *Matsa*, of *Nari-Khorsum;* and *Bong-Madma* of *Mangyul:* the *Zhunglam-Rongyul*, *Central Balti*, *Parkuta*, *Tolti*, and *Khartaksho*, of *Balti; Purik Proper*, *Ladak Proper*, *Rong Ladak*, and *Kakzhung*, of *Ladak; Tashikang*, *Namru*, *Gar Proper*, and *Seng*, of *Nari-Khorsum;* and *Shamtsang*, *Troshot*, *Tradum*, *Nyugu*, *Saka*, *Semukul*, *Kyado*, and *Zangzang*, of *Mangyul:* and the *Lhogyut—Hasora* of *Balti; Hembaps*, *Suru*, *Zangskar*, *Lungnak*, *Rupshu*, *sPiti*, and *Hanle*, of *Ladak; Tsotso*, *Chumurti*, *Rongchung*, *Guge*, *Daba*, *Kangri*, *Purang*, *Horba*, and *Bongba*, of *Nari-Khorsum;* and *Kungtang*, *Chamshen-Tsuglakang*, *Khyirong*, *Nyanam*, *Shelkhar*, and *Tingri*, of *Mangyul.*

The chief natural significance of the three Tibetan zones consists in the arrangement of the rivers, which generally preserve a main trunk in the *Zhunglam* with branches in the *Changyut* and *Lhogyut;* and in the differences of hygrometric climate, which make the southern zone more moist and snowy than the others. But the classification appears to be disturbed here and there, either by natural irregularities in the plan of the country, or by the intrusion of political elements: nor can I answer for its application farther E. than *U-Tsang.* Thus the *Zhunglam* is by some considered to pass from *Gar* into *Kangri* and *Horba*, because the *Gyalam*, or artificial *High road*, here lies to the S. of the natural *Mid-way;* and *Demojong* and *Lhopato* may be reckoned parts of the *Lhogyut*, though anomalous projections beyond the natural limits of the zone.

Another and important natural classification will be described further on.

Vertical Formation of the Table-Land.—Having sketched the general plan of *Nari* in horizontal extension, I must now explain

its vertical relief, as this is developed on such a gigantic scale that no true idea of the country could be formed without equal attention to *the third co-ordinate*.

The area of *West Nari* consists then of a dense mass of huge rocky mountains, whose habitable, or even accessible valleys, bear but a small proportion (with one remarkable exception) to the solid mass of mountain, too steep and high for any human uses. The loftier summits rise in all quarters to an elevation of 4 miles above the sea-level, a few of the highest (as yet measured) reaching nearly to 5; and the deepest of all the fissures at its very lowest point (the exit of the *Indus* at *Acho*) is still nearly 1 mile above the sea, whilst there is only one other (the exit of the *Sutluj* at *Namgya*) that descends to less than 2; so that the mean elevation of the whole is probably near 3 miles.

For a clearer comprehension of this mass it may be divided into its two component parts, viz. solid rock *in situ*, which constitutes all the mountains, and by far the greater part of the whole, and a much smaller proportion of alluvial soil composed of the débris of those rocks, and laid out in horizontal deposits which, accumulated in the fissures of the mountains, form the bottoms of the principal valleys.

The alluvial beds, as now existing, appear to be only the ruins of a former and much greater structure: entire plateaux of any considerable extent are the exceptions to the rule, and in most places they have been broken down again by some destructive agency, leaving nothing but a collection of huge fragments lodged in the hollows of the mountains most favourable to their retention, so that the aggregate area of all the remnants can hardly exceed, I suppose, a tenth part of the whole country. In some instances the destruction has been so great as to remove the old alluvium down to the very bottom of the mountain fissures, and a main valley even is thus degraded into a gigantic ravine, with its river running through a bottom almost impassable in a sharp angle of bare rock, whilst remnants of the ancient deposits still adhering to the mountain flanks thousands of feet above, attest a former valley expanded to the breadth of a mile or two.

The alluvium, in what may be presumed to be its original completeness, appears to attain its maximum elevation about 16,200 feet: at 16,500 it may be seen just rounding off the mountain feet and connecting them by undulated slopes with the lower flats, but at 16,000 it is often thoroughly developed in horizontal plateaux; and the uniformity of the maximum limit of elevation in all parts of the country is as remarkable as the invariable horizontality of the strata. The ancient plateaux are generally in such a fragmentary state that it is difficult to assign a minimum elevation for their original surface, but I doubt whether this is to

be found below 14,000 feet; and supposing it to have been laid out everywhere—as the very wide distribution of the fragments attests—at an average height of 15,000 feet, the old alluvium must have occupied nearly half the area of the whole country, often expanded into wide plains and broad connected valleys, whilst the mountains were more separated, isolated, and comparatively lower than we now find them.

The destruction of the primary alluvium has been succeeded or accompanied by the formation of a secondary order of beds, which abound in the lower valleys (where the primary banks have been most destroyed)—either simply as flat bottoms, or as high scarped terraces or broad shelving slopes between the mountain foot and river bed, or as "heaps of shot rubbish" spreading out of the mouths of lateral ravines into the main valleys; and most of these again exhibit marks of extensive subsequent destruction similar to that of the primary banks, though on a smaller scale: they are remarkable also for constituting the sole or chief sites for human habitation and agriculture.

The same cause has created a secondary class of valleys or ravines in the masses of the primary alluvium, where the original structure has survived wholesale ruin: these are oftenest mere ravines, with steeply scarped flanks, though measured by hundreds of feet, perpendicular cliffs of 100 vertical feet being common in *Ladak;* but in *Guge*, where the alluvial deposits are developed on the largest scale, the ravines become expanded into respectable valleys thousands of feet deep, with huge mountainous sides, sometimes in steep smooth slopes like the earthwork of an embankment, or broken into cliffs that vie with the grandest precipices of rock, and surpass them in the extraordinary artificiality of their appearance.

Irregularities in the original composition of the alluvium, and in its subsequent destruction, have caused a number of curious appearances in the secondary ravines. The cliffs are sometimes full of holes, such that the Turks have called one of them on the *Yarkend* road *Kuptar-Khana*, i. e. *Pigeon-House*—and the pigeon holes occasionally expand into caves large enough for the abode of Tibetan hermits. Sometimes alluvial aiguilles rise in sharp isolated points from banks otherwise crumbled down into gravelly slopes, and occasionally the crags and pinnacles of the more precipitous banks are so fantastic that it is difficult to persuade oneself they have not been cut into shape by the hands of man, or seen at a distance that they are not houses and castles; whilst some of the largest ravines —as those of central *Guge*—present the appearance of whole streets and cities of the most gigantic proportions and wonderful architecture.

Sometimes rock *in situ* protrudes through the alluvial sides of

the secondary ravines, and changes their appearance to that of a primary valley between mountains, or projects above the upper surface so as to form isolated hills in the midst of the elevated plateau; and less frequently an alluvial mass itself is so wrought as to resemble closely one of the smoother hills of solid rock.

The composition of the alluvial beds is well exhibited in the vertical sections so frequently cut through them. They consist of the débris of the surrounding mountain rocks disposed in horizontal strata, often very strongly marked by alternations of large boulders, coarse gravel, and fine sand or clay, the individual fragments of which are generally more or less rounded. Limestone seems to impart a great consistency to the alluvium, and deposits of this material sometimes occur, which are aggregated into a solid rock too hard to be broken by the hand, though showing no signs of geological metamorphism. The deposits of *Guge*, which are the most extensive we know of, appear to consist of more finely comminuted material in their central part, where furthest distant from the mountains, the great ravines there being flanked by cliffs half a mile high, which exhibit throughout their thickness a fine homogeneous clay with little gravel in it. The stratification of the alluvium seems to be horizontal in all cases, or at most very slightly sloped from the mountain foot to the valley middle, in accordance with the existing directions of the drainage. I have once or twice seen small faults where some of the strata had become canted from the horizontal for a few yards, but never anything like a general disturbance of the original position.

It is in the larger alluvial deposits of *Guge* that the fossil remains of large mammalia are found, which have reached the hands of Indian geologists under the *Bhotiya* name of *Bijli-Har*—a translation of the Tibetan *Dukrus*, i. e. *Dragon bones*, which the savans of *Kumaon* have translated into *Lightning-bones*. I never heard of these in any other part of *Nari*, nor has any English traveller actually found their site, but they no doubt come from the ravines in the vicinity of the *Sutluj*. The small shells which occur in the superficial strata of alluvium, close to the margins of some of the lakes, appear to be comparatively recent, and some of them perhaps of species still living in the lake water.

Being no geologist I cannot undertake to give a description of the rocks which constitute the mountain masses; but a few facts are obvious to ordinary observation. Granite and Metamorphic Schists are decidedly the most prevalent rocks throughout *West Nari*: Greenstone and Porphyries are also common, and Serpentine and Statuary Marble occasional: Limestones are abundant, particularly in the southern zone, and often contain vast quantities of Coral and other Fossils: Fossiliferous strata, containing Ammonites and Belemnites, have been found at several

points upon the Indian watershed all the way from *sPiti* to the *Saligrami Gandak* of *Naipal*—a line of four or five hundred miles.

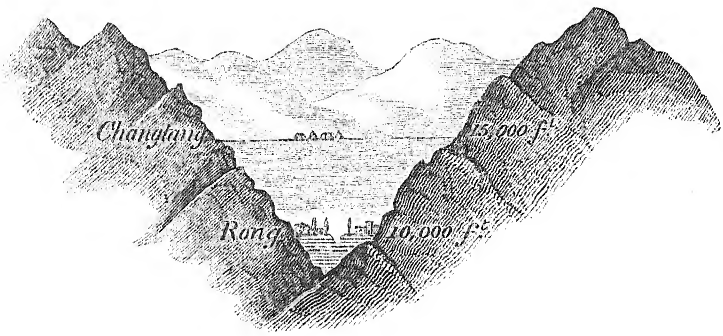
Among the metamorphic rocks there are some remarkable specimens of Conglomerate to be seen in perfection on the left bank of the *Indus* in central *Ladak*. These consist of ancient alluvial masses precisely similar to the existing ones, converted bodily to a sub-crystalline rock without any partial disturbance of the strata, but canted to a dip of 30° or 40°, in masses which appear (from the town of *Le*) to contain a continuous succession of strata 2 miles thick. The alternations of large boulders, coarse gravel, and fine sand, are all represented in bands of solid rock, projecting or receding from the average surface according to their greater or less compactness and resistance to wear; and all the boulders and pebbles of the original detritus may be seen embedded in their sandy matrix, but so thoroughly cemented together by the metamorphic agency, that they break through with the fracture of the mass sooner than separate from it.

Though unable to discuss the geology of the country in detail, I think it as well to state the general impression which I have derived from a long and extended observation of its surface. The immense extent of the existing alluvium, and the uniformity of its maximum elevation, lead me to infer that it must have been deposited under a general sea covering the whole country (in which it so occurs), and not by lakes, much less by rivers. The existing lakes are comparatively mere puddles, made by the drainage of the higher and smaller mountain ravines stagnating in slight hollows of the old alluvium; and the gigantic ravines in the ancient plateaux are out of all proportion to the contemptible rivulets that now creep along their bottoms, wandering over beds a thousand times too large for them. The universal horizontality of the strata, and the conformity of all the alluvial ravines to the existing directions of drainage, whilst the existing drainage itself seems quite inadequate to their formation, show that they must have been laid out whilst the framework of mountain was in its present form, and that no material convulsion of the rock could have accompanied the general upheavement; and the elevation which the alluvium attains in excess of the gorges by which the present drainage has an exit to the lower regions proves that it cannot have been deposited in the existing elevation of the table-land above the general ocean, but at the bottom of that ocean in a former state of the earth, and upheaved afterwards by the equable raising of a whole continent.

I must observe here, that though I have myself divided the alluvial beds into two classes, primary and secondary, this is merely for facility and brevity of description; and a much more

complicated and extensive classification may be necessary for a true account of their geological formation.

The preceding account of the rocks and alluvial plateaux, as met with in *West-Nari*, however geologically imperfect, will enable the reader to understand the natural classification of *Rong* and *Changtang*, into which the Tibetans divide the whole of their table-land; and the annexed figure will assist the explanation.



Rong signifies a *deep Valley*, low and warm enough for agricultural occupation, and generally a country containing such valleys. *Changtang* literally means the *North Plain*, but in common parlance an elevated plain, or wide open valley, too high and cold for any but pastoral uses, and generally a country of such valleys. The former description of country is produced by the destruction (or at least the absence) of the alluvial deposits, which in lowering the valley bottom also contracts it, and steepens its sides of mountain rock: the latter results from the preservation (or presence) of the alluvium in its original plateaux at great elevations, where the mountain masses occupy less of the area, diminished also in relative height and steepness.

Changtang accordingly is the prevailing character of *Nari* in its E. and central part, or *Mangyul* and *Nari-Khorsum*, where the beds of drainage are still very elevated; and *Rong* at its W. end, or *Maryul*, where the bottoms descend towards the main exit of the drainage by the gorge of the *Indus*. *Mangyul* is said to be *Changtang* in all its northern and central zones, and *Rong* only where some of the *Naipal* valley-heads penetrate its southern border. *Nari-Khorsum*, though mostly *Changtang*, is not without its *Rong*: in *Purang* the *Mapcha* river makes its exit by a valley very similar to one of Middle *Ladak*; and *Guge* is a strange compound of *Changtang* and *Rong*, as its secondary or alluvial valleys afford ample sites for agricultural villages in their lower parts, though their upper ends enter the pastoral uplands at the top of

the great plateau: *Tsotso*, the exit of the *Rupshu Sutluj*, is also *Rong*. *Maryul* has its share of *Changtang*, but chiefly at the E. end of *Ladak;* and all *Balti*, I believe, is exclusively *Rong*, unless the tract which some call "the *Steppe of Deosu*" be a little isolated scrap of *Changtang*. The western limit of *Changtang* crosses *Ladak* about the meridian of 77½° S. of the *Indus*, and 78½° N. of it; but the *Rong* of Upper *Ladak* projects to E. of the general line in the central part, and at the S.W. end there is a small detached piece of *Changtang* so far as 76½° (viz., *Rangdum*, in the high ground that divides the heads of the *sTot-Zangskar* and *Suru* valleys). The districts of *Changtang* in *Ladak* are—*Pangong*, with *Khargyam*, of *Tanktse; Hanle*, with *Kakzhung; Rupshu*, with *Lingti; Kharnak;* and *Rangdum*, above mentioned: and the joint area of these is about 10,000 square miles, leaving for the *Rong* districts of *Ladak* 20,000; but both of these include a considerable proportion of valleys utterly unoccupied either for agricultural or pastoral uses, and scarcely habitable from extreme narrowness and sterility.

In elevation the lowest limit of *Changtang* may be reckoned about 13,800 feet, and the highest of *Rong* 14,300, the mean line of demarcation being 14,000 feet.

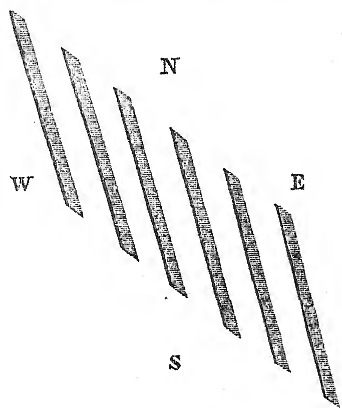
The term *Changtang—Highland* or *Upland*—must not be confounded with the *Changyut*, which signifies *Norland*, as the former is essentially independent of the three zones, and may exist indifferently in any of them, though it no doubt originated in the prevailing character of the north country. The term *Changpa* strictly signifies a *Norman* or *Norlander*, an inhabitant of the *Changyut* in fact; but in actual parlance it is often applied to the inhabitants of the *Changtang*, denoting merely a *Highlander* or *Uplander*, and commonly a shepherd of whatever region. *Rungba* is the inhabitant of the *Rong* country, a *Lowlander*, and generally an agriculturist.

Mountains.—The mountains that compose the bulk of *West-Nari* are not easily understood or defined. On ascending the highest passes, we can seldom see anything but a contracted view of mountain tops on all sides, looking very like chaos: no general view of the range under our feet is ever obtainable, as the passes naturally select the ravine-heads and lowest points of the ridge, which are not only flanked, but often almost surrounded, by the higher summits; and the valleys are commonly so steep and narrow, especially in the *Rong* country, that the view can hardly ever penetrate to an alluvial bottom, and the sight of any inhabited place from a pass top is most unusual. When travelling along the bottoms of the valleys, we generally see nothing but a narrow tortuous passage, between steep rocky walls, shutting out all extended view, and rather concealing than exhibiting the mountain

ranges of which they form but the mere lowest outworks: consequently it is only by an extended series of observations and inferences, joined and assisted by maps, that any regular arrangement of these mountains can be distinctly established; and my account of them is liable to error in proportion to the defects of my own map.

The general plan of the mountain system appears to me to consist of a series of parallel ranges running right across the breadth of the table-land in a direction so extremely oblique to the general extension of the whole as often to confound the one with the other, or to convert the transverse direction to a longitudinal one. The annexed figure may help to explain this.

Short transverse necks connecting the main ranges in some parts, and cross fissures cutting through them in others, together with projecting spurs of a secondary order, will suffice to convert the supposed primary arrangement into all the existing varieties of valley and drainage. Such connecting necks, when above 18,000 feet, become more or less confounded with the main ranges, and if not above 17,000 feet, often appear as low watersheds, just dividing the heads of two valleys lying in one line but draining opposite ways. Secondary spurs also may be so high and so obliquely joined to the primary ranges as to make it difficult to distinguish between the two; and the cross fissures may sometimes admit a main river to pass through a main mountain mass, in which case the continuity of the range is often evidenced by the extreme narrowness of the rocky gorge, or height steepness and geological correspondence of its sides.



Much of the Indian watershed seems to be formed in this way; the great snowy peaks lying mostly on the terminal butt-ends of the primary ranges, sometimes widened by lateral spurs; and the Tibetan passes crossing the low connecting links, whose alignement forms the main watershed, but not the main mountain-crest. Fromwhat little I know of the Turkish watershed, I should suppose the same formation to exist there also.

The general extension of *West Nari* being nearly S.E. and N.W., I consider the component mountain ranges to run S.S.E. and N.N.W., but more generally and more certainly they lie within the third and sixth sextants of the compass; and in the

few cases where they appear to enter the first and fourth, they seem capable of being resolved into the butt-ends of the others connected by inferior links.

The longest ascertained range in the interior of the country is the one flanking the right of the *Ladak Indus*, and dividing it from the valleys of *East Balti*, *Nubra*, and *Tanktse;* the length of this range is about 225 miles; its direction nearly S.E. and N.W.; and it runs almost all through *Ladak*, beginning rather short of the South-East frontier, but extending as much beyond its North-West into South-East *Balti*. The ranges on both sides of this chain are generally more meridional in their direction, so as to meet the left of the *Indus* and right of the *Nubra* river very obliquely; and they cannot be traced continuously to such a length as the preceding, the longest *ascertained* being rather more than 100 miles, dividing *Nubra* from *Kumdan*, but possibly extending further beyond the Turkish watershed. In *Nari-Khorsum* the longest ascertained range is that dividing *Guge Chumurti* and *Koyul* (of *Hanle*) from *Gar Namru Tashikang* and *Upper Kakzhung*, and in its middle part the *Indus* from the *Sutluj*, having a length of 150 miles, and direction of S.E. by S., N.W. by N. The range dividing *Horba Kangri* and *Gar* from *Seng* is perhaps longer, though our positive knowledge of it does not exceed 150 miles, approximately S.E. and N.W. The Peak of *Tise* or *Kailash* is the end of a long spur projecting from the S.W. face of this. There is also a range of more than 100 miles dividing *Ruduk* from *Tashikang* and *Kakzhung*, with a direction nearly S.E. and N.W.

I had no opportunities for measuring the height of inaccessible summits in *Ladak*, and could merely estimate some of the most conspicuous by view from lower barometric stations, in which estimates the most experienced mountaineer is liable to err by *thousands* of feet. On the whole I should suppose 20,000 feet to be a very common height for the average crest of the main ranges in most parts of *West Nari*. In the *Changtang* of *Ruduk Hanle* and *Rupshu* there is a good deal of mountain something lower, and some considerably lower in the *Rong* of *Purik*, and in most parts of *Balti*. The long range of *Central Ladak* does not average perhaps more than 19,000 feet; it is still less at its N.W. end, towards *Purik* and *Balti*, but at the S.E. contains some snowy summits probably much above that height. The range south of Central *Ladak* seems above the average height, and its most prominent peak, opposite to *Le*, is perhaps 22,000 feet. The mountains dividing *Tsotso* from *Hanle* and *Chumurti* are also above the ordinary height, and as Gerard estimated some of their peaks at 30,000, and *Porgyul*, measured 22,600, appears from *Guge* to be quite lost among them, the highest are not improbably 23,000 feet. The short range flanking the west of

the *Pangong* Lake appeared to me higher than any other in *Ladak*, averaging I should suppose 22,000 feet, with peaks of 23,000, the summits being covered with a wide belt of névée whilst my own barometric station at 18,800 feet was entirely free from all snow.* Dr. Thompson estimated one of the peaks at the head of the *Kumdan* valley at 24,000 feet; and from the top of the *Karakorum Pass* (itself 18,000 feet) he saw a range of mountains, still N. of the Turkish watershed, very snowy in August; therefore in all probability above four miles high.

In *Nari-Khorsum* my brother has measured a few of the peaks on and near the Indian watershed, by purely geometrical operations which assure the results within one or two hundred feet. The highest of these is *Kamet* (i. e. *the Snowless*—name doubtful), situated on the watershed of *South Guge* and *East Chongsa*, a most conspicuous landmark from all the elevated parts of *North Guge* and *Chumurti*, and also visible from *Almora* on the Indian side, where, however, its appearance is so modest that, till 1849, it remained unnoticed and unmeasured, though but 250 feet lower than the King of the Western *Himalaya*, *Nanda-Devi*. The main peak of this mountain is 25,500 feet, and the points of its two chief spurs about 24,000. Next to this is *Gurla Mandhata* or *Momonagli* (name doubtful), forming the end of a lofty spur that runs from the Indian watershed up the N.E. side of the gorge of *Purang*, till it suddenly terminates on attaining its greatest height immediately south of the lakes of *Kangri*: its highest summit is 25,200 feet, and other points of the same mass 22,200, 22,500, and 22,800 feet. The peak of *Tise*, or the Indian *Kailásh*, which is purely Tibetan though in the *Lhogyut*, is 22,000 feet; and some of the main range behind it is—to judge from its snow—quite as high, though less conspicuous from the S. and W. A peak of 20,500 towards the S.E. end of the range dividing *Gar* from *Guge*, though slightly prominent from this the lower end, appeared to be equalled if not exceeded by the average crest at the *N.W.* end of the same range, between *Chumurti* and *Tashikang*. The summits, of 18,000 feet and upwards, that project from the Indian watershed of *Daba*, or are detached from it in *Kangri*, look like mere hills compared with the neighbouring mountains, and might be subtracted without causing much difference in the general appearance of the country.

The passes, which are commonly the lowest part of the ridges, generally exceed 18,000 feet on the principal ranges in *Ladak* and *Nari-Khorsum;* if less than 16,500 they may, in the *Changtang*, be little better than Tibetan valleys; but in *Purik* and

* A pass of 17,000 feet, which connects the lower end of this range with the long range of *Ladak*, looks more like a valley than a mountain crest, so much is it exceeded by the main ridges on both its flanks.

Balti some of the main ranges perhaps may be crossed at such elevations. The highest pass I crossed in the course of my own travels was the *Zulang La*, leading from *Koyul* of *Hanle* into *Chumurti*, which measured (by boiling thermometer geometrically compared) 19,000 feet: but another pass of the same ridge distinctly visible a mile or two off seemed 500 feet higher, and this is the highest of which I have any cognizance. Passes between 18,000 and 19,000 feet are of the commonest occurrence all over *Ladak* and *Nari*, not excepting the second-rate range of *Middle Ladak;* and some of these are frequented by Turks and Tibetans even in midwinter.

The Tibetans call mountains *Ri*, and a mountain pass *La*. They have *proper names* for a few remarkable peaks and for all of the passes, but no general name for whole ranges; and when such appear upon our maps they are the misapplication of purely local names by English surveyors and European geographers. Thus the Tibetan *Para Lasa*, i. e. *Middle Pass*, the Turkish *Mus-Tag*, i. e. *Ice-Berg*, and *Kara-Korum*, i. e. *Black Gravel*, applied by the natives exclusively to the mere passes, and the Indian *Kailásh* to a mere peak, have been "raised to that wrong eminence" upon the map of Asia.

Valleys.—As the valleys of *West Nari* (in Tibetan *Lungba*) are the very essence of the habitable country, their names are generally identical with those of their inhabited places, which are often taken from the chief village, or from the *Khar*, i. e. *Castle*, or seat of local government; and the smallest ravines even have their names, in common with the hamlet pasture ground or encamping place contained in them, or names of their own when containing nothing. The terms *sTot*, *Yarma*, *Kongma* or *Kongnus* = *Upper;* *Parma* or *Parba* = *Middle;* and *Sham* or *Shamma*, *Mat* or *Madma*, *Yogma* or *Yognus* = Lower, are often used for the purpose of subdivision.

The general formation and arrangement of the valleys may be inferred in some measure from what has been said of the mountains that bound them, and the alluvial deposits that form their pavé. The prevailing direction of their main axes of drainage is of course like that of the mountain ranges, in the third and sixth sextants of the compass; but the exceptions to the rule are frequent, as a roomy valley may lie between secondary spurs of mountain, or even in the cross fissures of a main range, and will then usually have the opposite or transverse direction. The general arrangement may be briefly described to consist of one long central valley, traversing the whole *Zhunglam* from end to end, and a succession of shorter branches through the *Changyut* and *Lhogyut*, either joining the central valley or forming independent systems connected with the valleys of the *Indian Himalaya*.

The valley of the *Zhunglam* runs between 600 and 700 miles from S.E. to N.W., traversing the districts of *Seng-Tot*, *Seng-Mat* and *Tashikang* of *Nari*, *Kakzhung*, *Rong-Ladak*, *Central* and *Lower Ladak*, and *Khartaksho*, *Tolti*, *Parkuta*, *Central Balti* and *Rongyul*. Its minor branches on the N.E. side are very insignificant (so far as we know them); those upon the S. not penetrating to the *Lhogyut* include the *Kanji* valley of East *Purik*, *Yuru-Wanla* of *Lower Ladak*, *Koyul* of *Kakzhung*, and *Gar Proper*. In the *Changyut* the valley of *Shigar* is the only one of the secondary branches that joins the central valley direct.

All the rest of them, viz., *Khapalu*, *Yarma-Nubra*, *Kumdan* with *Chang-Chemno*, *lData* and *Chang-Parma* of *Pangong*, and *No* of *Ruduk*, with a few smaller branches from the S. side, first unite to form a great secondary trunk which runs the whole length of *Ruduk*, *Pangong*, *Tanktse*, *Nubra*, *Chorbat*, *Khapalu* and *Kiris*, parallel to the main valley of the *Zhunglam* (and separated from it by the long mountain range of *Middle Ladak*) before joining it in Central *Balti*. E. of *Ruduk* the arrangement of the valleys is unknown.

In the *Lhogyut*, the small valley of *Hasora* joins the *Zhunglam* of *Lower Balti* direct, at the very W. end of all Tibet. Next to this is the system of *Purik*, which joins the central valley at the frontier of *Ladak* and *Balti* by a short transverse trunk uniting four main branches, viz., *Shingo* (name doubtful), *Hemhaps*, *Suru-Kartse*, and *Waka-Molbi* (or *Pashkyum*). The system of *Zangskar* is more extensive; its main trunk (which is very narrow and tortuous in its lower part) running almost perpendicularly up to the Indian watershed, with several large branches, viz., the *Zingchan* and *sTot-Zangskar* from N.W., and *Marka*, *North-Kharnak*, *Zangla* and *Lungnak* from S.E.; the last of these itself a large system, branching into *Khargya*, *Shade Shun*, *Lingti*, *South-Kharnak* and *North-Rupshu*. *South Rupshu* unites several small branches before joining *Tsotso*, and the latter enters *Hangrang* of *Upper Kanor* at the same point where *sPiti* joins it from the westward. The system of *Hanle* joins the Upper *Rong* of *Ladak* obliquely from the S.E., and is of much less extent than the others of the southern zone. The *Lhogyut* of *Nari-Khorsum* is formed into one long chain of valleys running S.E. and N.W., from *Maryum-La* to *South-Hangrang*, through *Horba Kangri* and *Guge*, expanded to a great breadth in *Guge*, and narrowed about *Kangri* by the encroachment of *Purang*, which is a separate valley descending to the *Indian Himalaya* of *Naipal*.

The valleys of *West Nari* may be made any length from 1 mile to 700, according to the degree of subdivision or generalization adopted by the geographer. The alluvial bottoms are much more continuous in the *Changtang* than in the *Rong* country. In all

Ladak the longest expanse of uninterrupted flat bottom is perhaps the valley of *Nubra*, where, from *Agam* to the foot of the *Yarma* glacier, we may travel for 80 miles in a straight line over alluvial flats without once crossing rock *in situ*, and with no other ascent or descent than the ups and downs of the secondary alluvial banks —which rarely exceed 100 vertical feet—or the general slope of the valley, which is only 20 feet in a mile and almost insensible; but not above a third of this length can be seen at once in a straight unbroken vista, and the views here are perhaps more extensive than in any other valley of the *Rong*. In the *Changtang* of *Ladak*, the longest extent of straight open valley is *Kakzhung* on the *Upper Indus*, where the same direction is preserved for about 50 miles without interruption of the alluvial flat, and but 200 or 300 feet of general slope, with a good breadth and unbroken view for two-thirds of that distance. This is probably equalled or exceeded by some of the valleys of *Nari;* besides *Guge*, which is altogether anomalous and will be separately described further on. Some of the best valleys of the *Changtang* moreover are occupied in part or whole by lakes, such as the *Tso-Moriri* of *Rupshu*, whose basin has a clear open length of 20 miles; and the *Pangong* of *Tanktse* and *Ruduk*, where the aggregate length of open valley is more than 100 miles, though broken into three or four vistas, so that not more than 25 or 30 miles can be seen at once. The lakes *Mapham* and *Langak* narrow without shortening the valley of *Kangri*.

The breadth of valleys is of necessity generally greater in the *Changtang* than in the *Rong;* yet expanded plains are the exception to the rule even in the *Changtang*, and the upland valleys very often assume the appearance of mere passages between walls of mountain. In most cases, and especially in the *Rong*, the alluvial bottoms are defined with great precision by the extreme abruptness with which the mountain sides rise out of them, in sheer rocky precipices or slopes inaccessibly steep and rugged; and very seldom is there any blending of the mountain and valley by inferior undulating hills.

In the *Changtang* of *Nari*, the valley of *Kangri* appears to attain an extreme breadth of 5 miles, besides lateral recesses partly occupied by the lakes: parts of *Gar*, *Tashikang*, *Ruduk*, and *No*, are also said to be expanded into small plains. In *Ladak* the valleys of *Chushul* in *Pangong*, *Kakzhung*, *Mid-Hanle*, and *Tega Leptra* and *Pangpok* of *South-Rupshu*, are often 3 miles wide, seldom less than 1, and sometimes above 4, and the greater part of this fair open plain.

In the *Rong* of *Ladak* the breadth of the valleys may be estimated to average no more than ½ a mile: ¼ mile is very common, and some of the bottoms occupied by fields and villages are even less than a furlong.

In some parts of the *Rong*, the gorge of mountain rock is so contracted as to be wholly occupied by the river, quite uninhabitable, and sometimes impassable. This occurs even in the main valley of the *Zhunglam*, both in Upper and Lower *Ladak*, which, though nowhere actually impassable, is often very narrow and rugged; and in the lower part of the gorge of *Zangskar*, much of which is totally impassable excepting by the ice of the river in winter. The lower part of the *Kharnak* valley can be traversed only by incessant fording and wading of the river in the dry season: and in the *Tilat* branch of the same valley, the road for some miles lies nearly as much in the river as out of it; at one point passing through a natural archway of rocks so low that a horseman wading the stream must stoop his head to get through, and at another through a rocky gorge which the Tibetans aptly call *Tarson-Migarson*, i. e. *Horse-way no saddle-way*, being nearly narrow enough to scrape the saddle off a horse's back, whilst the bottom is filled with dangerous accumulations of snow or water.

In many other valleys, such as that of the *Maryul Changyut*, both above *Nubra* in the *Shayok* and *Kumdan* quarters, and below it in *Chorbat* of *Balti*, though the bottom itself may be sufficiently wide and flat, the passage is obstructed by the depth of the river and its repeated contact with the foot of precipitous mountains; and in these cases the valley may be just passable in the dry season by frequent fording and wading, or at some points by climbing over the rocks of the mountain side (roads and bridges being in this country generally out of the question).

One of the widest expansions of valley in the *Rong* is in Central *Ladak*, where, for a length of 15 miles, the breadth varies from 4 to 8, exclusive of the further recesses of the side ravines; the mountain flank on the left (S.W.) being approximately straight, and that on the right (N.W.) broken into deep bays—the mouths of lateral ravines—which are separated by spurs of inferior but steep and rocky hills, narrowing to points as they advance and descend towards the *Indus*. The town of *Le* is situated in one of these recesses, 4 or 5 miles from the river, and it enjoys a wider southern aspect than almost any other place in the *Rong* of *Ladak*. The valleys of *Nubra* are seldom less than 1 mile wide, and in the lower part of *Yarma* as much as 3, with a still greater breadth at the junction of the two valleys about *Deskit*. Central *Zangskar* has an extreme breadth of 5 or 6 miles about *Padum* and *Karsha*, where the *sTot valley* unites with the mouth of *Lungnak* to form the valley of *Sham-Zangskar*. The greatest expansions are generally at the junctions of two or more valleys, but the irregular shape of such places often renders it difficult to define their breadth; and as all my statements on this head involve some guess-work, they might be modified by an exact survey of the ground with instruments.

If stratified alluvial deposit be considered essential to the formation of a valley, the greatest elevation of any valley bottom cannot exceed the uppermost limit of that alluvium, or 16,500 feet. The mountain hollows about this height are seldom more than mere ravines, though in one or two places they may be found looking very like valleys even up to 18,000 feet; and it is possible that some slight wash of alluvium has been deposited up to that height.

The lowest depressions are to be met with in the gorges by which the main rivers make their exit to India. The gorge of *Purang* is explored only down to *Taklakhar*, where the bed of the *Mapcha* river is still about 14,000 feet (doubtfully estimated from adjoining stations). The gorge of *Rongchung*, or Lower *Guge*, may be defined by drawing a straight line from Mount *Porgyul* to the high peaks on the south bank of the *Sutluj*, which will cut the gorge under the *Piming La*, where the height of the river bed may be estimated about 9,000 feet (being midway between *Shipki* 9,700, and *Namgya* 8,600): this place is narrow and rocky, I believe, with little remains of the alluvium. The gorge of *Tsotso*, discharging the river of *Rupshu* into *Hangrang*, is about 11,000 feet: the highest point which the Chinese government allow us to explore here is the *Takha rDozam*, where the river bed at 11,600 feet is extremely contracted between huge rocks, some of which have tumbled across the stream and formed a natural bridge more picturesque than convenient: but the conflux of the river with that of *sPiti*, where both debouch into the open valley of *Hangrang*, is (according to Gerard) only 10,200; and at both these points there are large alluvial banks much higher than the river bed. The gorge by which the *Indus* leaves *Balti* has been explored down to *Acho*, at the conflux of the *Hasora* river, which is nearly its lowest Tibetan point; and the height of the bottom here appears, from boiling observations by Mr. Winterbottom, to be about 4500 feet.

The valleys have, of course, every variety of elevation between the limits above assigned. All the main ones are remarkable for the gentle slope of their longer axis of drainage, which, indeed, is rarely sensible to the foot or eye, and completely lost in the ups and downs of the subordinate alluvial banks. The valley bottom of *Yarma-Nubra* is elevated 11,700 feet at the foot of the glacier that fills its upper end, close below the Turkish watershed, and 10,400 feet at its debouchure in *Mid-Nubra*, being a slope of 1,300 feet in a length of 55 or 60 miles, or a little more than 20 feet per mile. The Upper *Rong* of *Ladak* has a slope of about 1,500 feet in a length of 40 or 45 miles (between *Chumatang* 13,500, and *Shara* 12,000), or about 35 feet per mile; the slope of Lower *Ladak* is not so steep. Among the small lateral valleys—that of *Sakti* and *Chimra* has a slope of 1500 feet in 10

miles (between *Tagar* 13,000, and *Kalaktartar* 11,500), or 150 feet per mile: the valley of *Marka* is nearly the same: that of *Hanu* has a slope of 3,500 feet in 8 miles (between *Handumir* 13,000 feet, and *Nyubibrangsar* 9,500), or 440 feet per mile; and this is one of the steepest. In the *Changtang* the slopes are generally (but not always) much flatter: *Khargyam* of *Tanktse* has a fall of 2,000 feet in 20 miles (between *Long-Kongma* 16,000, and *Erat* 14,000), or 100 feet per mile. The valley of *Kakzhung* is so flat for 50 miles (between *Tedur* 14,000 feet, and *Loma-Sumdo* 13,800) that the slope could not be determined by my single barometric observations; and the 200 feet which I have assigned to it, or 4 feet per mile, is little better than conjecture. Probably much of the *Changtang* of *Nari* is as flat as this last, and in the lacustrine basins flatter: the *Tso Pangong*, for example, attests the perfect horizontality of its valley for a length of 100 miles.

Great Alluvial Plateau of Guge.—The valley of Guge is at once an exception to the general rule of formation, and the most remarkable of all the valleys of *West Nari* (so far as known to us). The usual dense mass of mountains here gives place to a large crater filled up with the alluvial deposits so as to make a great plain, which is elevated from 15,000 to 16,000 feet, and interrupted only by tremendous ravines that have been formed by the destruction of the original deposits along all the lines of drainage, or here and there by a few little islands of inferior hill.

The general shape of the valley is a very acute triangle, having its apex adjoining to the heads of *Purang* and *Kangri* on the S.E., and its base to *Hangrang Tsotso* and *Hanle* on the N.W. *Chumurti*, at the N.W. corner, is essentially part of the *Guge* Basin, being contained within the same main watershed, and distinguished only by the projection of inferior mountains above the level of the alluvial plain, which converts it to a hilly district, with narrow valleys like the ordinary Changtang.

The S.W. side of the triangle, bounded by the Indian *Himalaya* of *Kyunam* and *Chongsa*, runs from E.S.E. to W.N.W., and in this direction the continuous length of plain (broken only by the alluvial ravines) measures 120 miles, in a straight line from the S.E. end of *Gyanima* to the *Shelti* ravine between the *Kiobrang La* and *Hukyu*, which latter may be gathered from Gerard's account (though he is not himself explanatory on the subject), to be the limit of the alluvial plateau in that quarter. On the N.E. the length of continuous plain is 90 miles, measured from *Tsiring* on the *Chumurti* border to the *Sutluj* near *Kyunglung*, in a direction S.S.E. and N.N.W. along the base of the mountains that divide *Guge* from *Gar* and *Tashikang;* the length being here diminished by the mountains of *Chumurti* at the N.W. end, and a group of low hills dividing *Gyanima* from the *Sutluj* and *Kyunglung* at the S.E. The greatest transverse breadth mea-

sured S.W. and N.E. is about 60 miles, passing through *Rabgya-ling*, and its least breadth across *Gyanima* only 15 miles.

These dimensions give the alluvial plateau an area of 4,500 square miles; any small defect in which by encroachment of isolated hills is probably compensated by extensions of the alluvium into ravines of the mountainous enceinte.

The main axis of drainage, exhibited in the course of the *Langchen* river, runs nearly parallel to the S.E. boundary of the valley, leaving the greater breadth of plateau on its N. and the greater length on its S. side.

The elevation of the plain averages probably 15,500 feet. The highest parts of it at the foot of the mountains exceed 16,000 feet: from boiling thermometer measurements, made in the vicinity of *Tsiring*, I estimated the height there to be 16,200 feet; some of the highest terraces that come up to the foot of the *Niti* Pass are about the same (and the height well corroborated by my Brother's geometric measurements), and Gerard also gives 16,200 for the height of *Zingchan*, near *Bekhar*, which appears from his account to be alluvial ground. 15,000 feet seems to be the minimum elevation of the original surface where not corroded by ravines, and this only near the banks of the *Sutluj* where the plateau is least elevated.

The plains of Daba are perhaps generally less elevated than the other parts of Guge, by a few hundred feet, and especially about Gyanima at the S.E. extremity of all, where the plateau is connected with the N.W. head of the valley of *Purang*.

The general fall from margin to centre of the basin may be reckoned about 1,000 feet: but this is not uniformly distributed; its base varying perhaps from 10 to 40 miles, and the slope from 25 to 100 feet per mile.

Though clean flat plains often occur between the ravines for many square miles together, the general surface of the plateau is somewhat diversified by terraces of various level, usually separated by ravines, but sometimes rising one from the other in steps, of which formation the most remarkable instance that I met with is between *Ling* and *Mangnang*, where a direct breadth of four or five miles, between two of the main ravines, is broken into six different terraces, with a height of 2,000 feet between the top of the highest and the foot of the lowest, the separating steps being sometimes smooth steep slopes and sometimes broken cliffs.

A large proportion of the original plateau—perhaps half—has been destroyed by the ravines, which, conforming always to the present drainage, run in multitudes from the mountain-foot on both sides, uniting, deepening, and widening till they enter the great central ravine of the *Sutluj;* and the heads of some of them are remarkable for completely cutting off the alluvial deposit from the mountain wall, against which it must have originally rested,

as at the foot of the *Niti* Pass, where the traveller to *Daba* has to descend abruptly 1,500 feet merely to rise again immediately 1,000, and in the *Shelti* ravine, between the *Kiobrang* Pass and *Bekhar* (described by Gerard). The ravines appear to moderate a little in the *Daba* quarter, and about *Gyanima* my Brother found there were none at all, the rivers running in shallow beds over the top of the plain.

I found the ravine of *Mangnang* at *Dakala* about half a mile wide across the flat bottom, and several others a quarter of a mile; and the great ravine of the *Sutluj* appeared to expand to the breadth of a mile between *Ling* and *Tsaprang*, though a little above *Ling* contracted to a very narrow gorge by rocks protruding through the alluvial sides. The dimensions from crest to crest of the ravine sides are commonly double and treble of the bottom breadths, and about *Ling* and *Tsaprang* the erosion extends irregularly over an immense breadth, difficult to define, but amounting I should suppose to 10 miles.

1,000 feet is a very common depth for the side ravines, even in their upper part near the mountains; and in their lower part, towards the *Sutluj*, they deepen to 2,000, 3,000, and perhaps more. I found the bed of the river at *Ling* to be elevated 12,400 feet, whilst the summit of the alluvial plateau was about 15,700 on the N. bank, and 15,200 on the S.; making a mean depth of 3,000 feet, all broken precipice of pure earth: but further W. the dimensions must be still greater, for Gerard made the bed of the *Sutluj* under *Bekhar* 10,800 feet, and the alluvial plateau of *Zingchan* 16,200, so that the ravine must there attain the depth of a full vertical mile (but whether all pure earth does not appear from his account).

Mean Elevation of the Table-Land.—Our knowledge of *West Nari* is hardly sufficient for the construction of complete or exact sections of the country, and any calculation of its mean elevation would be rendered very uncertain by the number of assumptions required to eke out the few actual measurements: but it seems to me that in *Guge* nature has by brute force effected some approximate solution of the problem in question. The mean elevation is in fact the height of an imaginary horizontal surface, leaving as much mountain above it as would just fill the valleys below it; and the formation of alluvial plateaux by the degradation of the mountains that contain them is a partial realization of the supposed process; which in *Nari* however has been stopped short of completion, as vast masses of mountain still remain above the highest of the alluvial flats; and this partial result is again partly undone by the subsequent destruction of so much of the original alluvium.

But in *Guge* I think the defect of the alluvium may be set

against the excess of the mountains, and the general level of the existing plateaux taken with great probability to indicate, approximately, the mean elevation of the whole tract as limited by the surrounding watershed. The Indian watershed is so far advanced to the N. as to exclude most of the great *Himalaya*, and the mountains of the north-eastern boundary are neither very high nor broad, reckoned from the elevated alluvial base of 16,200 feet, so that the whole mass of mountain within the watershed line may be conjectured with reason as no more than sufficient to fill the gigantic ravines that everywhere detract from the solid of the alluvium: if this view be correct the mean elevation of all *Guge* will be somewhere about 15,500 feet.

The mean of all *Nari-Khorsum* I should suppose to equal that of *Guge;* for though the valleys elsewhere are often less elevated, there is no where else (that we know of) such a deficiency of mountain. The mean of *Ladak* I think can hardly be less than 15,000 feet; considering that a third part of it is *Changtang*, as high as *Nari-Khorsum*, that the valleys of the Rong narrow as they deepen into mere ravines, and that all through the central meridian, in *Zangskar*, Central *Ladak* and *Nubra*, we find 11,000 feet valleys between 19,000 feet mountains. In *Balti* the elevations are considerably less, but the area also is smaller, and a mean height of 13,000 feet would only just compensate the excess of *Nari-Khorsum* over *Ladak*.

On these grounds I venture to assign 15,000 feet, *provisionally* and *approximately*, for the mean elevation of all *Western Nari;* and in this estimate, as in all others, my aim has been to prefer understatement to exaggeration.

Rivers.—The Tibetans seldom have any name for their rivers; they are generally satisfied to call every large river *Tsangpo* v. *Sangspo*, and every small one *Tokpo*, or any stream indifferently *Chu* (i. e. *Water*); and if any proper name be appended to either of these terms, it belongs less to the stream itself than to the inhabited valley or accessible ravine which it traverses. Moreover the inhabitants of the principal valleys sometimes call their rivers by the name of the place next above themselves, from which the stream comes to them, rather than by the name of their own district, as the *Nubra Sangspo* in *Khapalu* and *Chorbat*, the *Shayok Sangspo* in *Nubra*, and the *Kumdan Chu* at *Shayok*. The people of *Balti* call the large rivers *Gyamtso* instead of *Tsangpo*, which is little better than an abuse of language, however, as the word means *Great Lake*, and is properly applied to a sea or the Ocean. They also call the *Indus* the *Share Gyamtso*, i. e. *Eastern River*, after the quarter from which it flows to them.

The mythology of the Tibetans, being in advance of their geography, has excepted one or two of the large rivers from the

general want of names, but even here the term *Khabap*, i. e. *Vomitory Cataract* or *Fountain*, applies more to the mere source than the whole river: these exceptions are the *Senge Khabap*, i. e. *Lion Cataract*, the *Indus* of *Nari-Khorsum* and *Ladak*; *Langchen Khabap*, the *Elephant Cataract*, the *Sutluj* of *Kangri* and *Guge*; *Mapcha Khabap*, the *Peacock Cataract*, the *Karnali* of *Purang*; and *Tachok Khabap*, *i. e. Horse Cataract*, the river of *Nari-Mangyul* and *U-Tsang*, and ultimately the *Brahmaputra*: but on the whole these names are not commonly used by the unlearned, and I very seldom heard the term *Senge Chu*, *i. e. Lion Water*, applied to the *Indus* in Central *Ladak*. In the dialect of *Kanor* rivers are sometimes called *Ti*; and in this way the *Guge Sutluj* is named *Lingti*, the river of Ling, from the great monastery of *Tot-Ling*; and the *Tsotso River Parati*, from the shepherds' ground of *Para* in *Karak-Bargyok*. The term *Samandrang*, a corruption of the Hindi *Samundar*, i. e. *Ocean*, is applied to the united *Sutluj* of *Kanor* by a barbarism like the *Gyamtso* of *Balti*.

The general system of the rivers of necessity corresponds with that of the valleys. The longest trunk of the *Indus* drains the *Zhunglam* from end to end of the whole 600 miles. Its great northern branch drains all the *Changyut* of *Ladak*, and half that of *Balti*, for a length of about 200, the remaining 50 miles of *Balti* being drained by the independent affluent of *Shigar*. The *Changyut* of *Nari-Khorsum* is probably for the most part lacustrine, but at least 100 miles of it in the *Ruduk* quarter, comprising all the basin of the *Pangong* Lake, though not in active effluence, is connected by channels of dormant drainage with the system of the Northern *Indus* last mentioned. Of the remainder we are absolutely ignorant, and may suppose it connected either with the same system, or with that of the Upper *Lion* river of the *Zhunglam*, or even with the *Tachock* of East *Nari*, or with Turkish rivers of *Khotan*, or divided between several of these; but the scanty volume of the *Lion* river proves that there is no active effluence of any extent from the northward, and the gradual subsidence of the *Pangong* Lake that this can receive little from the eastward.

The drainage of the *Lhogyut* is divided between the southern branches of the *Indus* and the heads of the *Sutluj*; the former drain all the southern districts of *Balti* and most of *Ladak*; the latter a small part of *Ladak*, and all the *Lhogyut* of *Nari-Khorsum*, excepting the small section of *Purang*, which is a separate system drained by the Tibetan head of the *Naipal Karnali*, one of the chief sources of the *Gogra* of *Oudh* and *Behar*. In *Maryul* the drainage of the *Lhogyut* is not so united as that of the *Changyut*. South *Balti* is divided between the river of *Hasora*,

which runs to the *Indus* direct, and that of *Shingo* (name doubtful), which first joins the *Purik* river in *Ladak*. In South *Ladak* the main branches of the *Indus* are two, viz., the river of *Purik* and that of *Zangskar*, both a good deal subdivided, and the latter, which is much the larger of the two, notable as the main trunk of the *Indus* in respect of water volume, and connected at its E. end with the small lacustrine basin of North *Rupshu*. The branch of the *Sutluj* that drains South *Rupshu*, also connected with the small lacustrine basin of the *Tso Moriri*, after traversing *Tsotso* and receiving the smaller branch of *sPiti*, joins the main trunk of the *Guge* river in *Hangrang*, and there forms the *Sutluj* of *Kanor*. The basin of the *Langchen* is lacustrine in its upper part, containing the *Konkyu* Lake in *Horba* without active effluence, and *Tso Mapham* and *Langnak* in *Kangri* with a partial or intermittent one.

The following is a rough estimate of the areas of these basins and their principal subdivisions :—

	Square Miles.				
Indus of Nari-Khorsum & Upper Ladak	..	..	..	14,000?	
,, Zangskar and Lungnak . .	..	..	5500	6,000	
,, Lacustrine basin of North Rupshu, without effluence .	..	..	500		
,, Purik and Shingo	..	..	..	3,800	
,, Lower Ladak and Upper Balti	..	..	..	2,700	
,, Northern Indus of Khapalu, Nubra, Shayok, &c. . .	..	..	9000	15,500	
,, Basin of the Pangong Lake, without effluence . . .	..	..	6500?		
,, Lower Balti, with Shigar, and Hasora	..	..	..	5,000	
Total of Indus: Rivers	..	..	..	40,000	47,000
Lakes, without effluence .	..	..	..	7,000	
Lacustrine basin of Horba, without effluence	..	..	2000?	12,500	
Ditto of Kangri, with effluence . .	..	..	2500		
Sutluj of Guge	..	..	8000		
South Rupshu and Tsotso	2300	2800	4300	4,500	
Lacustrine basin, inactive	500				
sPiti and sPin	..	1500			
Hangrang	..	..	200		
Total of Sutluj: Rivers	..	..	..	12,000	17,000
Lakes, with effluence .	..	..	..	2,500	
,, without effluence.	..	..	..	2,500	
Karnali of Purang	..	..	..	..	1,000
All West Nari: Rivers	..	..	..	53,000	90,000
Lakes, with effluence . .	..	..	2500	12,000	
,, without effluence .	..	..	9500		
Tsaka and Matsa, unknown	..	..	..	25,000	

The chief watersheds are by no means observant of the main mountain ranges, the connection or separation of basins being often determined by cross fissures and secondary ridges. This is well exemplified in *Guge;* the watershed between the *Langchen* and *Mapcha* rivers, at the S.E. corner of *Gyanima,* lies across the alluvial flat, where it is only about 15,500 feet, or still 700 feet short of its extreme elevation; and the former river, instead of making its way out along with the latter by the open gorge of Upper *Purang,* breaks through the barrier of the *Hangrang* mountains by a narrow fissure between peaks of 20,000 and 22,500 feet. Had the *Langchen* river run out by the *Serting La* (supposing the necessary fissure in the mountains at that point), and joined the *Ladak Indus* through the valley of *Hanle* (supposing the necessary changes of level), such a course would have been more normal than the existing exit to *Hangrang,* as its direction would then have been from S.E. to N.W., and the mountains about the *Serting* are more notably depressed than any other part of the whole western boundary of *Guge.* The watershed between the *Indus* and *Sutluj* has a running length of nearly 500 miles, measured from the supposed position of *Maryum La* to the N.W. extremity of *sPiti;* and some considerable portions of this are drawn across the heads of valleys transversely to the main mountain ranges.

The prevailing direction of the principal rivers is, like that of the chief mountain ranges and valleys, from S.E. to N.W.; and the main trunks of the *Indus,* the *Nubra* river, and the *Guge Sutluj,* preserve this direction through the greater part of their courses; but the cross fissures, and other irregularities in the mountain ranges, admit of frequent exceptions to this rule (as in the river of *Hembaps* and Lower *Purik,* and the river of *Sham-Zangskar*)*;* and many of the larger affluents approximate to the same direction as the main trunks, so as to meet them very obliquely (as the rivers of *Shigar, Khapalu,* and *Yarma-Nubra,* the *Kanji Tokpo, Yuru-Wanla, Hanle,* and *Gar* rivers). Confluent branches also often meet from diametrically opposite quarters, both in the same line, and united turn off to some other direction, an arrangement which may be seen to pervade all the drainage of Upper *Zangskar* and *Lungnak.* In short, the general tendency of the main rivers is to flow from S.E. to N.W., or N.W. to S.E., and when opposed in that direction to break through the mountains till they can regain it in some other valley.

The approximate running lengths of the principal rivers are as follows:—The longest trunk of the Tibetan *Indus* is probably about 750 miles, reckoned from its lowest Tibetan point at *Acho* of Lower *Balti,* to its farthest sources in *Seng Tot* of *Nari-Khorsum.* The highest point actually attained (by myself) upon

the main stream (viz., *Demchok*, on the frontier of *Ladak* and *Nari-Khorsum*) is only 550 miles or so from *Acho;* but as Moorcroft and Hearsay headed the river of *Gar*, which is well known to be a feeder of the *Indus*, 130 miles higher up, and native information so far is tolerably precise, the course of the river may be said to be positively ascertained for nearly 700 miles. Little or nothing is known of the furthest sources in *Seng-Tot* or elsewhere, and the estimate of 50 miles for the remaining course depends upon native reports and conjecture. In the lower 550 miles, I have myself mapped about the upper half of that course throughout *Ladak*, and Lieut. R. Young has done the same for the lower half through *Balti*, our surveys uniting within 25 miles or so; but the credit of the first exploration of the river belongs to Moorcroft and Trebeck, and to Mr. Vigne.

The northern trunk of the *Indus*, or river of the *Changyut* or of *Nubra* (by some called the *Shayok*), has a length of about 300 miles from its source of greatest volume in the glaciers of *Kumdan*. But the rivulet of *Gyapshan* has a further course of 50 miles to the watershed about the *Karakorum*, and makes the extreme length of this river 350 miles. If, however, there were any active effluence from the *Tso-Pangong*, and the main trunk of the river extended to the furthest affluent of that lake on the S.E., the *Kumdan* river being reduced to a northern tributary, the extreme length would be increased probably to 400 miles.

The river of *Purik* derives its importance more from the number of its branches and their volume than from the length of any of them, its longest run appearing to be hardly 100 miles from the head of the *Shingo* branch in S. *Balti*.

The river of *Zangskar* and *Lungnak* has its source of greatest volume—which is also the same for the whole *Indus*—in the head of the *Monlung* of *Lingti*, perhaps in the little lake of *Yunam*, on the N. slope of the *Para Lasa;* and the length from this source to the conflux with the *Ladak Indus* (at *Tsoksti* in Mid *Ladak*) is 180 miles, making the whole course of the Tibetan *Indus* of greatest volume 525 miles, or less than five-sevenths of the probable extreme length of the longest course; but the *Tsarap* branch of the *Lingti* river is about 20 miles longer than the others, and, measured to the furthest head of this, the *Zangskar* river will have an extreme length of 200 miles. There is also the line of dormant drainage in the lacustrine basin of N.W. *Rupshu*, connected with the *Lungnak* river by the valley of *Kyangchung* and the *Toze Tokpo;* and the furthest head of this, in the eastern affluents of the *Thogji-Chemno* lake, is just about as far (from the point of junction near *Shun*) as the source of the *Tsarap* river.

The lowest Tibetan point of the *Langchen* or *Guge Sutluj* may be placed at the conflux of the *Hangrang* river under *Namgya*,

below which the joint river becomes purely *Kanori Bhotiya* or *Himalayan.* Its sources are somewhat complicated (as imperfectly known to us), lying between the *Chukar* (i. e. *White River*) from the Indian *Himalaya* on the S., the *Ser-Chu* (*Gold River*) or other streams from the mountains of *Kangri* on the N., and the effluence from the lakes *Mapham* and *Langak* on the E.; the two first being permanent, and the last partial or intermittent; and besides these, there is the dormant drainage of the *Horba* basin, which stagnates in the Lake of *Konkyu* on the extreme S.E. The *Chukar* is said to be as large as the united river of *Mensar* and *Tirthapuri*, when swelled by the melting of the *Himalayan* snow in summer; but we do not know whether it maintains this superiority on the average of the year, nor whether the intermittent contribution of the lakes be equal to the permanent affluence of the *Ser-Chu*, or other rivulets direct from the *Kangri* mountains; but the differences in both cases are perhaps small. Measured from these various sources, the length of the *Langchen* will be—from the *Darma Yankti* head of the *Chukar*, about 230 miles; from the head of the *Serchu*, behind *Kailash*, 245 miles; from the furthest affluents of *Manasarowar* on the S.E., 255 miles, which includes about 45 of the intermittent lake drainage; and from the watershed of *Maryum La*, at the S.E. extremity of *Horba*, probably about 320 miles, including 65 miles for the dormant drainage of the *Konkyu* basin.

The most important tributary of the *Guge Sutluj* is the river of *Chumurti*, which joins its right in *Rongchung*, 60 miles above *Namgya*, after running for 90 or 100 miles from the northward.

The river of S. *Rupshu Tsotso* and *Hangrang* has a course of 150 miles, from its furthest source in the head of the *Pangpok* valley to its conflux with the *Langchen* at *Namgya*: but the last 25 of this, in the valley of *Hangrang*, is only demi-Tibetan, lying a little S.W. of the line which I have assigned (though somewhat doubtfully) to the Indian watershed in this quarter; and the same character belongs to the river of *sPiti*, which joins that of *Tsotso* at the top of *Hangrang*, after a course of 80 or 90 miles from the westward. In *Rupshu*, the S.W. affluent of this river, from the N. side of the *Parang La*, though 15 or 20 miles shorter than the *Pangpok* branch, perhaps contributes as much water, because its sources are more *Himalayan*: there is also the dormant drainage of the *Tso-Moriri* basin, with an extreme course of 40 or 50 miles from the northward, and the furthest source of this is about as far as that of *Pangpok*.

The main sources of the *Mapcha* river of *Purang* lie in the N.E. slope of the *Himalaya*, N. of *Byans* of *Kumaon*; and from the furthest of these the river has a course of about 50 miles down

to *Taklakhar*, which is the lowest explored point. Perhaps 20 or 30 miles more of it may be Tibetan, but this is uncertain.

In *West Nari*, neither the length of a river's course nor the area of its basin is any sure index to its volume of water. Much more depends upon the position of its sources as regards snow, and something on the nature of the soil over which it flows. From the greater quantity of snow on the Indian *Himalaya* and the Tibetan mountains next thereto, the rivers of the S. are incomparably fuller than those of the central and northern zones. Thus the Tibetan *Indus*, which has its longest course of 750 miles in the *Zhunglam*, derives its greatest volume from the *Lhogyut*, no further than 525 miles; the *Senge Sangspo*, after a course of more than 400 miles through *Nari-Khorsum* and Upper and Middle *Ladak*, probably scarce exceeds in volume the upper part of the *Lungnak* river in Lower *Lingti*, not 50 miles from its furthest sources, or the joint river of *Purik*, after running less than 100 miles; and the discharge of the whole *Zangskar* river, after running only 200 miles, and draining a basin of 6,000 square miles, mostly in the southern zone, is perhaps tenfold of the water brought by the *Ladak Indus* in double of that course, and from double the area of country, in the central districts.

Rivers of considerable volume sometimes issue ready formed from glaciers; but these are not common in *Ladak*, and exist chiefly at the heads of the northern affluents of the *Nubra Indus*, whereby the volume of that river is made little inferior to the *Indus* of *Ladak* before the accession of the *Zangskar* river. In one or two instances also they are diminished or almost absorbed by running over a sandy bed; as the river of *Hanle*, which is fuller in its thirtieth mile at *Tara Sumdo*, than in its fiftieth at *Hanle Gunpa*, and reduced almost to nothing at its debouchure in the eightieth mile at *Loma-Sumdo;* and the river of *Kumdan*, which, 15 or 20 miles below its exit from the glaciers, is almost entirely lost in sand and gravel for as much further, but then comes up again, and regains its former volume.

The fluctuations of volume arising from the melting of the snow sources are very considerable; the annual changes are felt in every river and rivulet throughout the country, but the diurnal ones become obliterated at a short distance, and hardly affect the main trunks of the principal rivers, excepting those of the *Lhogyut* with affluents joining immediately from the Indian *Himalaya* (such as the *Lungnak* of *Zangskar* and the *Langchen* of *Guge*). In the *Lhogyut* the larger streams are often fordable and unfordable alternately at different hours of the day, and these hours varying according to the distance from the snow sources. As the snow melts most during the afternoon, the rivers will be fullest about sunset, within a few miles of their sources; and a further course

of 50 miles or so (according to the current) will bring the flood to the next sunrise.

The utmost irregularity prevails in the distribution of volume in the different parts of any one river; at one point a stream will be double, treble, even tenfold, of its breadth at another point a furlong distant; and the depth is equally variable, and very irregular in any one cross section; such great variations in the volume being of course compensated by equal and opposite changes in the current. In the alluvial bottoms of the principal valleys, the larger rivers generally run in broad flat beds of shingle, winding from side to side, and often subdivided by low islands, or spread into wide reticulated shallows; even the small rivulets affect this form whenever there is any flat alluvial bottom; and the condensation of the stream in a narrow rocky bed, though occurring both in the smallest and largest rivers, is comparatively uncommon.

The absolute volumes of the rivers are generally far inferior to those of the Indian *Himalaya*, and an unfordable stream is seldom to be looked for, unless in the *Lhogyut*, or in one of the main trunks of the other zones, and in summer; but numerical measurements of their actual discharge are still desiderata in both regions, and, in lieu of the former, I can only give a few loose estimates of breadth and depth, taken in crossing fords or bridges, or observed from the banks.

The *Ladak Indus*, at the highest explored part of its course in *Kakzhung*, flows through a wide flat, with a stream—often much subdivided—varying from 50 to 100 yards in breadth, and a gentle current of 2 or 3 miles an hour; and in October I found the fords here not above 2 feet deep, though in midsummer some of them exceed 3 feet. In the upper *Rong* the river is more condensed, and seldom or never fordable, being at some points not above 10 yards wide, with a most violent current, and the bottom quite hidden by the depth of water (though very clear), and the bridges vary from 40 to 80 feet in waterway. In central *Ladak* it resumes somewhat of the character it had in *Kakzhung*, being a good deal spread into wide shallows, with a moderate current: at two points, where most condensed, and unfordable, it is spanned by bridges having waterways of about 100 feet; but at *sPituk* under *Le*, it is easily fordable at all seasons, being subdivided into two streams, which in the middle of May I found each about 100 yards wide, and only 1½ feet deep, though in summer the depth is greater. Immediately below this, which is the last ford, the *Ladak Indus* becomes condensed again, and then joins the river of *Zangskar*.

The river of *Lungnak* becomes unfordable in summer, with a breadth of 30 or 40 yards, immediately below the conflux of its

main head-streams in *Lingti*, only 40 or 50 miles from the furthest sources. In its lower part, after the accession of several large affluents, it is much condensed, with a deep rapid stream, and average breadth of 50 yards. On entering the wide alluvial flats in the open valley of central *Zangskar*, it spreads in subdivided streams, but still unfordable at their deepest, over a breadth of half a mile, till its junction with the river of *sTot Zangskar.* The united stream is then condensed again, and confined to a narrow rocky bed for the rest of its course through *Sham Zangskar*, its volume being at the same time much increased by several tributaries, the last and largest of which, from *Kharnak*, is itself, in summer and in the lower part of its course, an unfordable river. At *Nyerak*, in *Sham Zangskar*, Dr. Thomson found the river hemmed in between high rocky walls, only 40 feet wide, with a rapid current, and spanned by a common wooden bridge; and from this to its conflux with the *Ladak Indus*, it is impassable except on ice in winter.

In Lower *Ladak* the united *Indus* is generally condensed into a deep surging river, sometimes expanded to a breadth of 100 yards, and sometimes contracted to no more than 10, in the latter cases very rapid, and always of unfordable depth. The principal bridge here, at *Khalatse*, has a waterway of about 70 feet.

Moorcroft found some of the heads of the *Purik* river hardly fordable in the beginning of summer, and he estimated the united trunk of the river below *Khar Rul* as equal to the *Ladak Indus* under *Le*.

The northern *Indus*, which rises at once with a considerable body of water from the glaciers of *Kumdan*, is said to be almost entirely absorbed in a sandy part of the valley 30 miles below, but appears again in its full volume further down. It becomes unfordable in summer below the conflux of the large stream from *Chang-Chenmo*: thence to *Shayok* I found it from 30 to 100 yards wide, and, though flowing through a broad open valley, often condensed into a single stream, and generally unfordable in the middle of September. Between *Shayok* and *Agam* the valley is very narrow and rocky, and in the end of April I found the fords—of which there were no less than sixteen to be crossed in 30 miles—from 60 to 180 yards wide, and 1½ to 3½ feet deep; and this part of the river becomes impassable during the summer months. Through *Nubra* the river runs in a wide open flat, and is always fordable at several points, even below the conflux of the large affluent from *Yarma Nubra*, being much spread into wide shallows with a gentle current, and attaining an extreme breadth of a quarter of a mile. Below this the valley becomes contracted again, and the river more condensed and rapid, its breadth commonly from 50 to 100 yards, but under one of the

bridges only 80 feet; and it is generally unfordable for the rest of its course through East *Balti,* though not without exceptions in the dry season. Some expansion occurs in *Khapalu*, and Dr. Thomson found the river fordable here in the beginning of November, with a breadth of 200 yards and average depth of 2 feet; but immediately below this it is considerably augmented by the large affluent from North *Khapalu*, and becomes condensed again into a deep unfordable stream down to its junction with the main trunk of the *Indus* at *Kiris*.

According to Mr. Vigne, the northern *Indus* is 150 to 200 yards wide close above its conflux with the central river, and this latter only 80 yards wide, but deeper; and Dr. Thomson supposes that the discharge of the two streams may be nearly equal, whilst other travellers have even considered the former to be the larger. But these are mere guesses; and, considering that the two southern branches of *Zangskar* and *Purik* alone drain a joint area as large as the whole northern basin, excluding the inactive lacustrine basin of the *Pangong,* and much moister in climate, and that the whole basin of the central and southern river is nearly three times that area, it seems pretty certain that the discharge of the central *Indus* must be very much greater than that of the northern branch.

The authorities above mentioned state the united *Indus* at *sKardo* to be from 100 to 200 yards, or often more than 500 feet, in width, and 9 or 10 feet deep in the centre, even in winter, with a moderate current; and it here receives a considerable accession from the northern affluent of *Shigar*. Mr. Vigne describes it as "a furious rapid" in the contracted gorges of *Rongyul;* and it continues probably to be deep and narrow for the rest of its course through Lower *Balti*, its volume at the same time being increased by the river of *Gilgit* and other affluents. There is no extant account of the *Indus* near its lowest Tibetan point.

The southerly position of the *Guge Sutluj* gives it a respectable volume among Tibetan rivers. The mouth of the *Chukar*, its chief southern source below the lakes of *Kangri*, is said to be forded with difficulty sometimes in summer. The main trunk of the river, a little above *Tot-Ling*, is crossed by an iron chain-bridge with a span of about 100 feet, the stream being here contracted between rocks and unfordably deep; but immediately below this it is spread out again over a wide alluvial flat, and fordable in many places between *Tot-Ling* and *Tsaprang*. I have not heard of any fords below *Tsaprang;* but there are two bridges in *Rongchung*, and a third in *Hangrang*, close above the conflux at *Namgya*, which Gerard states to have a span of 74 feet.

The western head of the *Sutluj* is rather a scanty stream in the

upper part of its course through *Rupshu*, and often spread in shallows to a great breadth—at *Tronyor*, near *Chumur*, to a quarter of a mile; but it becomes condensed on entering the narrow rocky valley of *Tsotso*, and is generally unfordable in summer for the rest of its course through that district. Close above the conflux of the *sPiti* river in *Hangrang*, Gerard found it 98 feet wide, and unfordable in the middle of August, but said to be fordable with a depth of $2\frac{1}{2}$ feet in the dry season. The *sPiti* river was smaller. According to the same authority, the united river of *Hangrang* is spanned by a 92-feet bridge at *Kyakhar* (v. *Shelkhar*), but in two other places measured 85 and 90 yards, which he considered its average breadth, the stream being deep and rapid.

The *Mapcha* river of *Purang* appears to be unfordable in summer under *Taklakhar* (50 miles from the furthest sources), and a little above that is spanned by a bridge of about 50 feet.

The general flatness of the valleys on the Tibetan table-land renders the fall of the principal rivers far more moderate than those of the Indian *Himalaya*, and the secondary mountain rivulets, which are more rapid, have no considerable volume; so that neither of them can compare with the thundering cataracts that form the cis-*Himalayan* sources of the Indian rivers. My measurements of the running lengths of the rivers, and of the elevations of the points taken on them, are not exact enough to give the falls with much accuracy, but those contained in the table, p. 45, may be taken as useful approximations.

It appears from the table that the fall of the main *Indus* attains its minimum (so far as known), of 3 or 4 feet per mile, in the upper part of its course, in the *Changtang*, and its maximum, of near 30, immediately below that, in the upper *Rong;* whence it subsides again, with some irregularities, to about 25 feet per mile in Central *Ladák*, 20 in Lower *Ladak*, and 15 in *Balti;* and these limits nearly include the falls of the other principal rivers, excepting in their highest or lowest parts, which are sometimes steeper than 30. The greatest fall observed in the head of any river, fairly out of the mountain ravines, was only 45 feet per mile; but there may be others steeper. In both branches of the *Sutluj*, the falls increase rapidly as they pass from the Tibetan table-land to the slope of the Indian *Himalaya*, attaining at last to maxima of 80 and 120 feet per mile, or nearly double and treble of the greatest Tibetan falls. By non-advertence to this fact, Gerard fell into great exaggerations regarding the probable elevation of the lakes of *Kangri* at the head of the *Guge* river.

Falls of Rivers in *West Nari.*

	Points of Measurement.	Elevation.	Difference of Level.	Running Distance.	Fall.	Part of River.
		Feet.	Feet.	Miles.	Ft. per Mile.	
Main Indus.	Highest explored point at Demchok of Kakzhung	14,000	200	65	3	Changtang.
	Conflux of Hanle River at Loma Sumdo . .	13,800	100	25	4	Upper Rong.
	Mahe	13,700	1900	65	29	
	Tuna	11,800	1400	50	28	Central Ladak.
	Conflux of Zangskar River at Tsoksti . .	10,400	1400	60	23	Lower Ladak.
	Hanudo	9,000	500?	25	20?	
	Conflux of Purik River at Morol	8,500?	1000?	75	13?	Upper Balti.
	Conflux of Nubra River at Kiris	7,500?	3000?	185	16?	Lower Balti.
	Lowest Tibetan point at Acho of Hasora . .	4,500?				
	Total		9500	550	17	
Northern Indus.	Exit of River from Glaciers at Kumdan . .	15,000	2400	95	25	Kumdan } Ladak.
	Conflux of Changchenmo River at Pholongkemo	12,600	1600	50	33	Shayok } Ladak.
	Agam	11,000	900	55	16	Nubra } Ladak.
	Khoro	10,100	1200	45	27	Chorbat } Balti.
	Siksa	8,900	1400?	55	25	Khapalu } Balti.
	Conflux with main Indus at Kiris . . .	7,500?				
	Total		7,500	300	25	
Yarma Nubra.	Exit from Glacier	11,700	1400	70	20	Yarma Nubra.
	Conflux with main River in Mid Nubra . .	10,300				
River of Zangskar.	Valley head of Tsarap branch	15,500	1100	25	44	Tsarap } Lungnak
	Conflux of main sources in Lingti . . .	14,000	1500	55	27	Shun-Shade } Lungnak
	Conflux of Khargya River at Purni . . .	12,500	700	25	20	Lungnak } Lungnak
	Conflux with sTot River in Mid Zangskar .	11,800	1400	70	20	Sham Zangskar.
	Conflux with Ladak Indus at Tsoksti . .	10,400				
	Total		5100	175	29	
Purik.	Head of Hembaps branch at Matayun . .	10,900	2400?	75	32?	Purik.
	Conflux with Indus at Morol	8,500?				
Langchen Sutluj.	Exit from Tso Langak	15,200	1700	55	31	Kangri } Guge.
	Below Kyunglung	13,500	1100	60	18	Guge } Guge.
	Tot Ling	12,400	1200	55	22	
	Bekhar	10,800	1100	25	44	Rongchung } Guge.
	Shipki	9,700	1200	10	120	
	Conflux with River of Hangrang at Namgya .	8,500				
	Total		6700	205	33	
Western Sutluj.	Head of N.W. branch in Pangpok	16,200	2100	60	35	Rupshu.
	Kyungtsang, below Chumur	14,300	4100	50	82	Tsotso.
	Conflux of sPiti River	10,200	1700	25	68	Hangrang.
	Conflux with Guge Sutluj at Namgya . .	8,500				
	Total		7700	135	57	
sPiti.	Conflux of Khyibar Affluent	12,300	2100	55	38	sPiti.
	Conflux with River of Tsotso	10,200				

Lakes.—The lakes (in Tibetan *mTso*) form rather an important item in the drainage system of West *Nari*, as their basins occupy in all probability not less than 12,000 square miles (and possibly much more if the unexplored parts of the north-east be lacustrine), the whole of which is exclusively in the *Changtang*, where the flatness of the general level and absence of deep fissures favour such accumulations of the drainage.

The largest of all the lakes is the *Pangong*, which receives half the drainage of *Tanktse* of *Ladak*, and all of *Ruduk* of *Nari*, and, were it not a lake, would be the longest trunk of the northern branch of the *Indus*. Its basin has a mean length of about 110 miles directed S.E. and N.W., with a breadth of 60, and area, therefore, of 6,500 square miles. Though not actually explored to the whole of this extent, it is not likely to be less, and may be very much more, including dormant drainage to the eastward.

The lake itself has a running length of 100 miles probably (about half of which is actually explored), and an average breadth of only 3 miles or so, making the area 300 square miles. The middle part of the length is directed nearly E. and W., the N.W. quarter being turned northward, and the S.E. probably southward.

The character of the containing banks is for the most part very steep and rocky, scarcely leaving a footpath along the water's edge, but exceptions to this occur in several places; all along the S.W. side of the northern horn there is a flat or shelving alluvial bank, sometimes a mile wide, giving site to the agricultural hamlets of *Pangong*, where mountain rivulets admit of them; and there are also said to be wide plains open to the lake in the southern horn, at *Ruduk* in the S., and at *No* on the N. side, but these formed in whole or part by the mouths of the lateral valleys opening into the immediate basin of the lake.

The plain of *Ot*—which is 7 or 8 miles long, with an extreme breadth of 3 miles, on the N. side, about 10 miles W. of the lake's mid length, at the mouth of the *Chang-Parma* valley—encroaches altogether on the proper bed of the lake itself, which is here singularly contracted, for 2 or 3 miles, into a narrow channel like a large river, having a minimum breadth of 50 yards of unfordable depth.

The lake has at least eight permanent affluents; three only are actually explored in the N.W. half, but we have precise information of five more in the S.E. Of the former, the longest has a run of 40 or 50 miles (through *Chang-Parma*), but the shortest, of only half that course (from *lData*), has the largest volume; of the latter, it seems probable that one passing *Ruduk* (from *Chagang*, &c.) has a run of 60 or 70 miles, and another, debouching at *No* (from the N.), is said to be hardly fordable at its mouth in summer.

The *Pangong* has no effluence whatever; but there is an open valley connecting the N.W. end of its basin with that of the

Tanktse affluent of the *Nubra* river, *viâ Muglib*, the length of dormant drainage between the edge of the lake near *Jaktil*, and the first appearance of the *Muglib* rivulet in a scanty spring at *Wangtong*, being 7 or 8 miles; and the spring, being sub-saline, is considered by the Tibetan inhabitants as a filtration of the lake water. The watershed across the head of the valley is almost imperceptible, but lies probably at *Donzho Lhato*, only a mile from the lake, and scarce 100 feet above its present surface. The present level of the water is about 13,400 feet.

All along the banks of the lake there is a well-defined zone of horizontal watermarks, extending to a height of perhaps 70 feet above the present surface, formed both by calcareous concretions, and by erosions on the foot of the marginal rocks, corresponding marks being also visible in parts of the alluvial shore; and the uppermost of these lines no doubt marks the level of the existing watershed at *Donzho.* The gradual subsidence of the lake is established by further evidence. The plain of *Ot*, which is raised only 10 or 12 feet above the present water-line, consists of fine earthy strata full of small shells, which are very perfect and unaltered, if fossils at all of the most recent sort, and some of them closely resembling (if not identical with) a small species still living in the *Tso-Rul*, though none were observed in the water of the *Pangong* itself. Although the inhabitants of *Pangong* have no tradition regarding the origination of *Ot* by the subsidence of the lake, its gradual desiccation in the present (*i. e.*, human *v.* historic) era seems probable; and I was informed by a Tibetan, who had visited the lake in company with Moorcroft in 1821, and again with myself in 1848, that the water had receded perceptibly from the encamping ground at *Jaktil* during these 27 years, which, as the shore there is flat, might have been done by a very slight subsidence of the water.

The water of the *Tso-Pangong*, in the greater part of the lake, is very salt (not the salt of the sea, but Epsom salts, or some other compound of Soda), and the solution seems doubly concentrated in the contracted channel at *Ot;* but at the S.E. end of the lake it is said to be quite fresh and potable, which no doubt arises from the greater affluence of mountain streams in that quarter.

The *Tso Rul* and *Tso Shaldat* are two small lakes, situated in a flat valley, which connects the *Chushul* valley with that of *Ruduk*, parallel to the *Pangong*, and a few miles S. of its middle part, with a length of 50 or 60 miles, and average breadth of 1, uniformly elevated about 14,400 or 14,500 feet, and with no sensible watershed, its western and longer portion forming the basin of the *Tso Rul*, and a few miles at the E. end that of the *Shaldat.* The *Tso Rul* is about 15 miles long E. and W., and 1 mile broad, with a single scanty affluent 10 or 12 miles long entering its E.

end, and one or two small springs of fresh water rising in the hill foot at its margin; the lake water being salt, like that of the *Pangong*, though in a less degree, and without any effluence, though the basin is quite flat and open towards the *Chushul* valley. The *Shaldat* is only 3 miles long, and at the utmost 1 wide, with a very scanty and intermittent affluent to its S.E. corner, no effluence, but equally open to the *Tso Rul* or to *Ruduk*, and its water not so salt as the other, but still undrinkable. Both of these lakes are surrounded by signs of modern subsidence like the *Pangong*.

The general system of the *Tso Pangong* may be finally explained by saying, that a very slight elevation in the country about *Kesar Gidpo* (between the two small lakes) would suffice to send out the *Shaldat* by *Ruduk* and the *Tso Rul* by *Chushul*, into the great lake, and an elevation of one or two hundred feet at *Nertsong* (at the S.E. end of the *Pangong*), with an equal depression at *Donzho* (at the N.W. end), to drain off the whole into the *Nubra Indus* by *Tanktse* and *Shayok*; but if the present state of things last long enough, the two small lakes will become extinct, and the *Pangong* divided into two lakes, separated by an isthmus at *Ot*.

The lakes of S.E. *Nari*, at the head of the *Langchen Sutluj*, drain in all a basin about 90 miles long S.E. and N.W., and perhaps 50 wide, making an area of 4,500 square miles. The S.E. half of this, comprising the valley of *Horba*, contains the *Tso Konkyu*, lying immediately under the W. foot of *Maryun La*; it has not been explored by any English traveller, but my Tibetan informants represent the lake to be long and narrow like the *Tso Rul*, but larger—perhaps 20 miles long and 2 wide, or 400 square miles in area—with no effluence, yet no high ridge between it and the lakes of *Kangri*, and certainly belonging to the same system of drainage; the water salt; and the elevation probably between 15,500 and 16,000 feet.

The north-western half of the same basin comprises the greater part of *Kangri*, and contains the *Tso Mapham*, or Indian *Manasarowar*, and the *Tso Langak* (or *Oma Tso*, i. e. *Milk Lake*), the *Rakas Tal* or *Rawan Rhad* of the Indians. Detailed accounts of these have been already published in the volumes of the Calcutta Asiatic Society, and I here confine myself to their more prominent geographical features. They lie together in a large southern recess of the *Kangri* valley, S. of the mountains that impart this name to the whole district and include the notable peak of *Tisé*—the Indian *Kailash*—and N. of the still more gigantic *Gurla*; they are parted off by detached groups of inferior mountain from *Horba* and the *Tso Konkyu* on the E., and from the head of *Purang* and *Gyanima* of *Guge* on the W.; and a spur of low hills—partly alluvial, I believe—projecting from the foot of *Gurla*,

divides the two lakes by an isthmus 4 or 5 miles wide, also partly shutting off the eastern one from the wide flat valley on the N. They are both upon the same level (within a few feet), at an elevation of 15,200 feet; and both of the purest fresh water, in spite of much saline exudation in many parts of their banks.

The eastern lake *Mapham* is of oblong or oval shape, 15 or 16 miles long E. and W., and 11 or 12 broad N. and S., making an area of 150 square miles. It is known to have several affluents from the high snowy mountains that flank it on the N. and the S., though the English explorers, confined as yet to the W. side, have not actually crossed any of them; and one of them, from the *Kangri* mountains on the N.E., is said to form a small fresh-water lake, called the *Tso Khurgyal*, shortly before its debouchure into *Mapham* (the high road to *U-Tsang* going between the two lakes). Its effluent runs through an opening in the hilly isthmus into the western lake: I found it a swift stream 100 feet broad and 3 deep in October; and its exit from the lake was seen by Mr. J. E. Winterbottom and my brother, Richard Strachey, from a height a few furlongs off; though Moorcroft crossed this very place without finding the stream, even in August, the time of highest flood—whether from its being then dry, or from its percolating through a bar of shingle close to the lake, as asserted by some of my native informants, is not apparent.

The western lake *Langak* has probably about the same area as *Mapham*, but an irregular shape, with a length of 20 miles N. and S., and extreme breadth of 15, measured obliquely across its S. end, the N. end narrowing off to a point; at the S. end there are two or three small rocky islands, the only known instances of such in the lakes of West *Nari*. My brother and I have between us completed the circuit of this lake, so as to leave no doubt of its affluents and effluents; the former comprise the effluent of *Mapham* above noticed, two streams from the *Kangri* mountains on the N.E. as large as that, and a much smaller one from the valley of *Jungba* in the hills on the S.E. The effluence to the *Langchen* river is from the N. point, which I crossed however in October without finding any running stream, or any marked channel for one, though the flatness of the ground, its partial inundation in shallow pools, and obvious descent of the level towards the river, entirely corroborated the native accounts of an intermittent effluence in seasons of flood. It is worthy of notice that one branch of the *Jungba* valley is connected with valleys draining into *Gyanima* of *Guge;* and the level of both so nearly flat, and the dividing watershed so insensible, that the depression of a few feet at this end, with an equal elevation at the N. point of the lake, would certainly turn the effluence into the *Chu Kar*,

through the plain of *Gyanima*, where there now exists a small lake 5 or 6 miles long and 1 in extreme breadth.

The basin of the *Tso Moriri*, in South *Rupshu*, connected with the *Sutluj* through *Tsotso* and *Hangrang*, consists of two separate parts, the one of permanent and the other of intermittent drainage. The former, to the N.E., has a length of 28 miles N. and S., with a breadth of 25 miles at the N. end, but only 3 or 4 at the S., making an area of about 400 square miles; and this contains the lake at its S. end: the latter joins at the S. point of the former, from the S.W., having nearly an equal area, with a length of 25 miles N.W. and S.E., and mean breadth of 17; and including half of this the whole basin may be reckoned equivalent to 600 square miles of permanent drainage. The surrounding mountains are not above 19,000 feet, and still less in the southern part, and generally sloped off to the lake with a margin of broad shelving bank. The lake itself has an oblong shape, with a length of 14 or 15 miles N. and S., breadth of 3 or 4, and area of about 45 square miles; its elevation is 15,200 feet, and its water subsaline. The longest permanent affluent is that of *Gyang* and *Tsakshang* from the N.W., with a length of 25 or 30 miles; that of *Karzok* on the W. is much smaller, and two or three others are insignificant summer rivulets.

The intermittent affluent which joins the S. end of the lake, after a course of 40 or 50 miles in two branches from the westward, is the same with the *Pangpok* branch of the *Rupshu* river. This stream sends half its waters into the lake and half to join the *Parang* branch of the river at *Nurbu-Sumdo*, sometimes both at once and sometimes alternately in different years; an instance of distomosis which, if insignificant for the smallness of its scale, is remarkable as the only one that I have ever seen or heard of in all *West Nari*, or the Indian *Himalaya*. The mouth of the *Pirse* valley (which is the eastern continuation of *Pangpok*) is contracted into a narrow rocky gorge, opening at right angles into the W. side of the *Leptra* valley (which is the southern prolongation of the lake's immediate basin), where the latter is 3 or 4 miles wide; and though the bottoms of both are generally very flat, a large fan-shaped alluvial delta spreads out of *Pirse* right across the breadth of *Leptra;* and the middle part of this bank, being as usual the highest, forms a low flat ridge, so exactly medial to the debouchure of the river that the stream wanders over it for some way, in widely subdivided shallows, before ultimately taking to one or other slope of the delta, or to both; and once parted the two streams cannot unite again, because the medial rise of the bank forms a complete though low bar across the whole bottom of the *Leptra* valley. A change of a very few

feet in the relative levels in some parts of the divaricating alluvial bank, would suffice to put an end to the distomosis, and determine the flow of the *Pirse* river either wholly into the lake, or wholly into the river of *Rupshu*.

The *Tso Moriri* has no effluence; but an elevation of 100 feet at its N. end, with an equal depression at the S., would send it all into the *Rupshu* river, along with the river from *Pirse*, through *Leptra* to *Nurbu-Sumdo*. The old idea that the lake actually formed the source of the river, obtained by Herbert and others from distant inquiries, and still figuring on most English maps, though not strictly correct, is thus founded on geographical facts, and a careless observer might mistake the southern branch of the *Pirse* river for an effluent of the lake.

I saw no signs of desiccation in the lake, nor is the existing watershed across the *Leptra* valley consistent with any considerable height of water above the present surface.

The lacustrine basin of North *Rupshu*, connected with the system of the *Lungnak Indus*, is also divided into two parts. The eastern one, containing the lakes of *Tsowar*, is a triangular area of about 200 square miles, the lakes being situated near the middle of its W. side, where there is an opening through low hills communicating with the western division of the basin at *Rokchung*. This latter has an equal area of 200 square miles, contains the valleys of *Tanglang Rok* and *Kyangchung*, and opens at its south end into the *Toze Tokpo* branch of the *Lungnak* at *Pangtik*; it has no permanent rivulets of any size, and but one or two insignificant ponds often quite exhausted in the dry season.

The main lake of *Tsowar* has an area of a few square miles only; it has one or two small mountain affluents, the chief of which from the southward expands a little before its debouchure into a pond or small lake of fresh water. It has no effluence, though the opening for it exists as above mentioned: and Dr. Thomson observed upon the surrounding hill-foot a line of ancient water-marks, corresponding with the low valley watershed, and indicating a desiccation of the lake, about 150 feet above the present level. The elevation is somewhere about 15,000 feet; the water of the larger lake-salt, and a small part of the marginal concretions sometimes found to be edible sea-salt.

The name *Tsowar* signifies *Between the Lakes*, and is applied to the summer camp of the *Rupshu* shepherds in that situation. *Thogji Chemno*, the *Great Benevolence*, is the name of the *Lha*, or local deity, who has his *Lhato* or dedicated turret, on the N. side of the larger lake, which itself must be called by the same name for want of any other.

In the preceding notice of the lakes I have made no allusion to

their depth, because it is not known in any instance; but with reference to the general formation of the valleys in which they are embedded, it may be conjectured to range within two or three hundred feet.

The following peculiarities are worthy of remark, as seeming to pervade the whole system. Every one of the Lakes has a connexion by open alluvial valley with the general river drainage of the country: none of them can ever have been much (or 100 vertical feet) fuller than they now are: they are not to be found below 14,000 feet: some of them are drying up without any effluence, under the sole effect of evaporation or subterranean filtration: and those with an effluence are invariably fresh-water, those without it invariably salt.

In addition to the lakes above described, there are several small ones, all fresh-water, formed by the stagnation of rivulets in flat valleys or ravines, generally at high elevations; but they have no geographical importance, and are often mere duck-ponds, though interesting as objects of topography or landscape, and seldom without Tibetan names. The largest that I have heard of is the lake of *Kyung*, said to be 3 or 4 miles round, in the ravine of *Nidar*, entering the left of the *Indus* in Upper *Ladak*, probably at a height of 15,000 feet; and the most curious that I have seen, is a little pond a few furlongs round, completely insulated in a crater of low serpentine hills that protrude through the alluvial bottom, in the valley of *Yarma-Nubra*, between *Tiritsha* and *Panimik;* but this is in the Rong, at a height of only 10,700 feet.

Glaciers.—Glaciers are well known to the Tibetans under the name of *Kangri*, i. e. *Iceberg*, which is also loosely used to denote any high mountain covered with perpetual snow or *nevée;* but, as might be expected in a country of such little snow, they form rather the exception than the rule, and are not commonly to be found away from the Indian watershed.

In the central part of *Ladak* the only instances I met with were in the very lofty range dividing *Pangong* from *Tanktse* Proper, where several small glaciers of the incipient class fill the deeper of the top ravines below the general coating of nevée, but yet so elevated, that from my camp in the valley of *Ko*, at 17,800 feet, the lowest of them still seemed 1,000 vertical feet above me. From the shore of the *Pangong*, about *Man* and *Merak*, the ends of some of these may be seen hanging upon ledges of the mountain overhead, and their true character is sufficiently attested by the Tibetan inhabitants, who (incurious as they generally are in such matters) have observed their progressive motion and *éboulement*, as evidenced by fragments of ice falling to the foot of the mountain. Symptoms of terminal moraine may also be seen descending through the lateral ravines in the valley of *Muglib;*

and the head of the *Ko* valley above mentioned appears to be composed of ancient moraine rather than alluvium.

But the chief reservoir of Tibetan glaciers seems to be in the S. face of the Turkish watershed, which the joint observations of English travellers and native reports prove to be full of them, and many of the first class both for size and formation. The main trunk of the *Nubra* river issues from two of these, at a place called *Kumdan* (by the Turks *Chongtash*, i. e. *Willow Boulders*), where the position of the glaciers is such as to cause most devastating *débacles*, which I shall describe further on. Dr. Thomson visited this place, and has given an account of the glaciers.

I myself found the river of *Yarma-Nubra* issuing full-formed (being 50 yards wide, with an extreme depth of 1½ feet, and very rapid, in the beginning of October) from a large glacier, entirely occupying the head of the valley and (so far as Tibetan information goes) rendering it impassable. I estimated the breadth of the glacier, in its lower part, to be ¾ of a mile; and its length is such that, after ascending perhaps 2 miles, I was unable to see the head of either of the two branches into which it is divided 4 or 5 miles above the lower end. The thickness of ice seemed at least 200 feet. The elevation of the lower end is about 11,700 feet, which is probably 8,000 feet below the mean level of perpetual snow in these regions (viz., 20,000 feet). Wild juniper trees grow all about the hill sides along its lower part, and though the valley is not actually inhabited for several miles below, a fragment of alluvial bank on which I encamped might easily have been converted into a corn-field in immediate proximity to the foot of the glacier. The glacier is remarkable for the extreme flatness of its level, and the abrupt contact of its ice with the steep walls of the granite mountain on both flanks, in which points it follows the character of the retaining valley bottom. The surface also is very free from moraine, often exhibiting the pure clean ice; and although passable with care and toil, in its lower part at least, the crevassation is so excessive that the whole glacier seems to consist of an aggregation of great lumps—each as big as a house, and jammed together in the utmost disorder—rather than a continuous mass with cracks in it: a formation which, I think, must be ascribed less to the disruptive inequality of motion than to the action of surface melting, which produces a network of rivulets that cut grooves in the ice, soon deepening into chasms, which often insulate and undermine great blocks, till they subside or tumble over into new forms of confusion. Glaciers, however, to be well understood, require much experience and specific study, as well as days and weeks of exploration; and my own hasty observations on the *Kangri* of *Yarma-Nubra* may be superseded by more elaborate inquiries hereafter.

The *Tulumbuti* affluent of the *Yarma-Nubra* river also rises from glaciers, which are passed on the summer road to *Yarkend*, upon the S.W. of the *Saser La* (as mentioned by Dr. Thomson). Mr. Vigne found several glaciers in the *Shigar* and *Khapalu* valleys, aligning with those of *Kumdan* and *Yarma-Nubra;* and the native travellers between *Yarkend* and *Balti* testify to a very large one upon the Turkish watershed, at the head of the *Braldo* branch of *Shigar*, which forms a serious obstacle to this route, and gives the Pass its Turkish name of *Mustag*, i. e. *Iceberg*. Mr. J. E. Winterbottom and Lieut. R. Young found another still farther to the N.W., beyond the Tibetan frontier, in the northern head of *Gilgit*.

In connexion with glaciers, I must notice the occurrence of certain permanent beds of frozen snow, or Valley Nevée, which I met with in two or three places of the *Changtang* in the middle of summer, when the snow-line was thousands of feet higher, and in situations where they could not be ascribed to avalanche or to unusual shade (as in the low summer snow-beds of the Indian *Himalaya*). The Tibetans call these snow-fields *Dar*, and assert them to be permanent, and constant from year to year in the same places. The largest that I met with were in a wide sunny valley, among low snowless mountains; and all of them in the beds of rivulets where most flat and marshy; the snow always hard frozen, with a very irregular surface, such as often occurs in glaciers or nevée; and the beds more or less broken up into patches, with every variety of thickness up to 3 or 4 feet. I have not been able to form any distinct opinion of these *Dar*, whether they have in fact any peculiar cause and constitution of their own, or whether they are mere sporadic extremes of the lowest perpetual snow; but to help the resolution of these questions by future observers, I here record the instances which attracted my own notice.

11*th August*, 1848.—In *Chang Parma*, of *Pangong*, a *Dar* about 3 furlongs long and 1 wide, and 2 or 3 feet thick, at *Mitpal Yogma*, the valley bottom elevated 16,100 feet and tolerably open. 17*th Idem*. A small *Dar* at *Phea Tot*, bottom elevated about 16,500 feet, and rather contracted. From two or three mountain passages in the vicinity, the mean snow-line was estimated about this time to be nearly 20,000 feet. 21*st June*, 1849.—In South *Rupshu*, passed two large fields of *Dar*, covering several acres, in places 4 or 5 feet thick; one at *Manechan-Sumdo*, 15,800 feet, and the other 3 or 4 miles above it towards *Pangpok*, about 16,000 feet; the valley bottom being a mile wide, and exposed to the sun all day, and the surrounding mountains low and snowless; the mean snow-line estimated, from a neighbouring mountain passage the day before, at 17,500 feet, but a fortnight later up to 19,000 feet.

Débacles.—The great valley of the *Maryul Changyut* appears to have been subject, from time immemorial, to devastating floods rising from débacles in its north-eastern head. The earliest traditions of them take the form of mythology, and magnify them to a scale fit for the giants and Titans, by confounding their effects with the extant ruins of the ancient alluvial era. Thus, the Tibetan inhabitants of these valleys relate that the oldest and greatest of the floods was effected by three of the "*Lha*"—i. e. *Local Deities*—to whom they still erect towers, and offer sacrifices: *Rangisha* of *Sakti* let loose the waters in the head of the valley at *Kumdan; Zangnam* of *Yarma-Nubra* dammed them up at the gorge of *Khoro* between *Nubra* and *Chorbat;* and *Koyak* of *Nubra* drained them off again by breaking *Zangnam's* dam; and the supposed marks of all these operations are to be seen thousands of feet above the present level of the river.

The oldest flood of which I could get any credible matter-of-fact account occurred only about seventy years back, and was witnessed by the oldest inhabitant of *Shayok*, then a young girl, now an old woman of eighty, who described it to have been on a great scale like that of 1835: between these, there seems to have been no flood of any note.

The one last mentioned occurred on the seventeenth day of the fifth moon of the "*Sheep Year*," which was some time in June of 1835. As the valley is not permanently inhabited above *Shayok*, and none of the *Yarkendi* caravans happened to be at *Kumdan* at the crisis of the débacle—though there but a day or two both before and after it—there were no eye-witnesses to its actual commencement; but the *Yarkendi* travellers have been observant enough to ascertain and describe the cause, and their accounts have been confirmed by Dr. Thomson's visit to the spot in 1848.

The débacle originates in two glaciers a mile or two asunder, the upper one of huge dimensions—perhaps a mile wide—coming from lateral ravines on the proper right of the main valley, so transversely that in process of time they slide right across the bottom of the latter, and after abutting upon the steep wall of rock upon its E. side, are thrust upwards by the pressure from behind till the ice reaches a vast height, in the upper glacier—perhaps 700 vertical feet, above the valley bottom. This obstructs all the drainage of the upper valley—probably a running length of 50 miles, and a basin of several hundred square miles—and perhaps some portion of the glacier-river itself, till the waters become accumulated into a large lake between *Kumdan* and *Gyapshan;* and under the weight and solvent power of this body of water, together with the continued pressure of the descending glacier, the lower end of the ice is at length burst asunder with a sudden and violent disruption, discharging the accumulated

water all at once in a torrent of immense volume and rapidity, hurrying along with it vast quantities of the overturned ice and moraine.

Travellers who passed *Sultan-Chuskul* a few days after the débacle, found the valley full of blocks of ice as big as houses, and so spread with heaps of soft mud that it was impossible to get up to the *Saser* Pass into *Nubra*, though the flood-water had all run off. Only ten or twelve years before the débacle, the foot of the glacier was not within a quarter of a mile of the eastern mountain, and the *Yarkend* road lay through the open passage; but within that period the jamming of the glacier, and damming of the *Gyapshan* water, had rendered the valley impassable above *Kumdan*, and obliged the road to take another line to the E. of these obstructions; nor was the disruption of the ice in 1835 sufficient to restore an opening practicable for the road, or offering security against an early recurrence of the débacle, the upper glacier being still impassable when Dr. Thomson visited it in 1848.

Shayok, the highest permanent habitation of this valley, is distant about 100 miles from *Kumdan*, and the village being situated on a bank 200 or 300 feet above the river, is much beyond the reach of the greatest known floods. That of 1835 is said to have passed it by night, and to have mostly run off by the next morning; though, if the statements which the villagers made to me were true, the water must have risen nearly 50 feet where the bottom is about a mile wide. It passed Mid-*Nubra*, which is 60 miles below *Shayok*, some time before daybreak, and had run off by noon of the same day. It here swept away all the lower half of the village of *Lagzhung*, with ten out of the twenty-two houses, and all their inmates, men and cattle; and the village of *Deskit* suffered equal loss in its low-lying quarters. These were the only two villages in all *Nubra* low enough to be touched by the flood. At *Lagzhung* I found fragments of the old fields standing 5 or 6 feet above the low sandy waste of the river flat; and as the remaining part of the village is only about as much higher, the flood could not have risen here above 8 or 10 feet; but attaining even that height, it must have spread into the mouth of the *Yarma* valley several miles.

In *Chorbat* of *Balti*, from 30 to 80 miles below Mid *Nubra*, and chiefly in the further part of that distance, no less than 150 farms were swept away from the low-lying lands in the river-bed, but with less destruction to human life, as the flood passed here between day-break and sun-rise, and the inhabitants, warned by the roar of the approaching torrent and trembling of the earth, had time to effect their escape, with the loss of lands, houses and cattle. The main part of the flood-water is said to have run off

from *Chorbat* in a few hours, and nearly the whole of it in two days The more destructive ravages did not extend below *Chorbat* or Upper *Khapalu*, but the inundation was dangerously great down to the debouchure of the northern valley at *Kiris*, in Mid *Balti*. Mr. Vigne has made some mention of its effects upon the united Indus at *sKardo*.

Throughout the 300 miles, from *Kumdan* to *Kiris*, the flood committed great havoc with the natural brushwood of tamarisk, hippophae, and willows, that grew abundantly in the river-bed; many square miles of valuable *Tsok* (*i. e.* thorn shrubbery) were thus destroyed in Mid *Nubra*: and all the way from *Agam* to *Kumdan* the *Yarkendi* traveller has still to lament the conversion of the pleasant little thickets and grass-plots that once gave him shelter and forage into barren wastes of sand and gravel. Further mischief was done by the violence of the torrent ploughing up deep holes in the softer parts of the river-bed, some of which still remain to render the stream unfordable, and increase the difficulties of the eastern route to *Yarkend*. The most dangerous mountain-path I ever crossed in my life was necessitated by one of these unfordable depths 10 miles above *Shayok*. For 150 miles below *Kumdan* the valley bottom was strewn with fragments of the glacier, the largest of which were several years in melting away: in 1848 I myself saw the residual moraine of some of them, half-way between *Agam* and *Shayok*.

The Tibetan peasantry are not exact enough in their mode of reckoning time to admit of any precise determination of the velocity of this flood; but I think it may be assumed that it did not pass *Shayok* before midnight, nor *Khapalu* after 6 A.M., making not less than 150 miles in 6 hours, or a rate of 25 miles per hour; but it may have been much more rapid.

In spite of so great a cataclysm as this in 1835, a débacle from the *Kumdan* glaciers occurred again in the next "*Hog-Year*," or 1839; but this was of much less extent, and passed *Nubra* at mid-day; and as all of the villages liable to inundation had been destroyed by the former flood, merely carried away the cattle and herdsmen that happened to be out at sea in the river flat; and in the upper part of the valley it did a little good perhaps, in levelling some of the mischievous pits and mounds that had been ploughed up by the great flood of 1835.

Mr. Vigne has associated these Tibetan débacles with some extraordinary floods of the *Indus* observed in the plains of India; but the two are, I believe, quite incommensurate both in scale and dates of occurrence, and the latter well known to have been caused by landslips altogether below *Balti*.

Subterranean.—No traces of volcanoes have been seen or heard of in any part of West *Nari*.

Hot springs occur in all quarters. They have been noticed by English travellers in more than a dozen different places, which is probably not near all that exist; these are generally very scanty, never up to the boiling point at their issue, and sometimes accompanied with gaseous exhalations.

Earthquakes are not unknown: I myself experienced a slight shock of one in Central Ladak (at *Chimra*, evening, 1st of June, 1848), and Dr. Thomson mentions another at the head of the Northern Indus (at *Morgo Chumik*, near *Kumdan*, 23rd of August, of the same year), but the state of several old buildings in *Ladak* proves that none of any intensity have occurred there for the last 250 years at least.

Climate.—Temperature.—The mountainous contour of the Tibetan Table-land gives rise to a great variety of temperature-climates, corresponding with the various elevations of the country, besides what differences arise from other causes, such as northing or southing in latitude, expanse or contraction of valleys, exposures to sun and wind, &c. The diversities of climate thus produced are in fact innumerable, and I can only attempt to notice one or two of them, chiefly in *Ladak*, to which region my own observations were mostly confined.

The town of *Le*, elevated from 11,800 to 12,000 feet, may be taken in point of elevation as an average of the inhabited valleys of all *Ladak;* but its site on a south face of granite rock, backed by high mountains on the north, and exposed to a greater expanse of south sky than almost any other place in the *Rong* country, raises its temperature probably above the average of equal elevations.

Continual frost, lasting in the shade throughout the day, is nearly coincident with the winter quarter in the town of *Le*, but in less favoured localities it begins much sooner even at much lower elevations. Thus in a north ravine of *Chorbat*, elevated 12,000 feet, the temperature was only 28° at 2 P.M. on the 4th of November, 1848. Constant frost set in on the 13th of the same month at *sKurbuchan* of Lower *Ladak*, elevated only 9,700 feet, with a south aspect; and from this up to *Le*, during the next ten days, I found the side rivulets (all with a south exposure) little better than cataracts of ice, and the *Indus* rapidly filling with sludge. In my lodgings at *Le* the frost was hard and constant from the beginning of December to the end of February: in any part of the house away from a fire, water froze speedily, and, if left so, remained in the form of ice throughout the season; and during the coldest parts of the winter, water, ink, milk, &c., would freeze in spite of fires, and close to them; the house, however, was a large one, kept in the Tibetan fashion, well exposed to the open air, and not many degrees warmer. In this situation

I never saw the thermometer below +2° Faht.; but as this was at 9½ A.M. (10th of February, 1848), and the exposure of the instrument by no means perfect, it cannot be taken as the true external minimum: the weather, however, about that time was much colder than the average of the winter. On the whole, the winter temperature of *Le* town may be said to range between 0° and 30°, to be colder than usual when below 10°, and warmer than usual when above 20°.

The rivulet of the *Le* valley is one mass of ice throughout the winter months. The *Indus*, below the town, at a height of 11,000 feet, freezes over during the same period; but owing to the great rapidity of the current, and to springs in the river-bed with a subterranean temperature, the ice is by no means continuous or durable. All the larger rivers may be reckoned to freeze over in winter down to the lowest level of *Ladak*, or 8,000 feet, though, for the causes above mentioned, their ice is often very much broken. Dr. Thomson found the *Indus* frozen over at *Khartaksho* of *Balti*, about 7,700 feet, on the 19th of December, 1847.

The rise of temperature about the vernal equinox is great and sudden in the town of *Le*, owing to the sun then striking on a multitude of brick and stone walls and granite rocks that his rays cannot reach in winter. In the fields, the moderate night frosts of spring appear to cease in the middle of April, although thin films of ice may be seen a month later about the shallows of the *Indus* 1,000 feet below—an effect, no doubt, of greater nocturnal radiation in a more open situation.

The summer temperature of *Le* is very hot if the direct effect of the sun's rays be taken into account, but quite the reverse as regards air temperature in the shade. The highest temperature I ever observed there was (at 3 P.M. 5th of July, 1848) 69° in good shade and wind, in the fields below the town, at a height of 11,800 feet, the thermometer just before sunrise on the same day having been down to 53°; and on the 23rd of the same month, at a station about the same elevation a little higher up the *Indus*, the temperature rose to 71° at noon in perfect shade and wind: as the weather had been unusually hot about the time of these observations, I consider that the ordinary maximum of perfect shade temperature at a height of 12,000 feet, in Central *Ladak*, does not exceed 70°. But perfect shade is very rarely to be found in this land of bare rocks, and the best attainable in most places will admit so much reflected heat as to raise the thermometer 8 or 10 degrees. Under such circumstances I once saw the thermometer up to 81½°, at 1½ P.M. on the 1st of September, 1847, at *Pok* of Lower *sPiti*, elevated 11,600 feet, the latitude, however, being 2° S. of *Le*.

Night frosts begin at *Le* in the middle of September probably.

In the valley of Mid-*Nubra*, at an elevation of 10,500 feet, in the autumn of 1848, the first ice was to be seen in the end of September. By the middle of October, in the same locality, the night frosts became very sharp, and, after that, continued increasing whilst I was descending to lower elevations, and by the end of the month, in Lower *Nubra* and *Chorbat*, the day maximum, in cloudy weather, was little above the freezing point, at heights of 12,000 feet.

My acquaintance with the lower parts of *Ladak* is so small that I cannot give any separate account of climates warmer than *Le;* but long excursions in the *Changtang* enable me to add a few particulars regarding the colder climates of greater elevations.

Elevations not above 14,000 feet appear to be exempt from night frost for the greater part of the summer quarter. At heights of 15,500 feet it freezes probably every night of the year. The greatest height at which I ever passed the night without finding ice in the rivulets in the morning was 15,300 feet, viz., at *lData* of *Pangong* on the 2nd and 3rd of August, 1848; but during the next two weeks frost occurred every night, at other places of equal or greater elevation in the same district. In 1849, when encamped by the *Tso Moriri*, at a height of 15,200 feet, I experienced frost every night from the 23rd of June to the 3rd of July; and in travelling through the uplands of *Hanle Chumurti* and *Guge*, during the next three weeks, at elevations generally exceeding 15,000 feet, I found the rivulets frozen nearly every morning, excepting in the ravines of Central *Guge* below that height.

The maximum shade temperature, at heights of 15,000 feet, is probably about 60°; but as good shade is rarely forthcoming in such places during the middle of the day, the thermometer will often be higher. I once saw it up to 70°, at 1½ P.M. on the 11th of September, 1847, at *Tronyor* of *Rupshu*, elevated 14,900 feet. The day temperature continues mild enough at these elevations till the autumnal equinox, after which it decreases very rapidly, and the frost becomes constant, sooner or later in the month of October. At *Hanle Gunpa*, elevated 14,500 feet, the thermometer still rose above 40° during the afternoon in the first week of October, 1847, but there was a good deal of reflected heat here from the walls of the building. During the second week of the same month, in the valley of *Kakzhung*, averaging 14,000 feet, the temperatures were between 35° and 40° during the warmest part of the day, nor was there any permanent ice in the *Indus;* though the night temperatures were very low, the thermometer ranging from 6° to 11° at sunrise—an instance, I suppose, of increased nocturnal radiation in an open plain. The greatest cold which I ever myself experienced in *Ladak* was in crossing from *Chorbat* of *Balti* to *Hanu* of Lower *Ladak*, in the

beginning of November, 1848, the temperature at the N. foot of the Pass, elevated 14,600 feet, not exceeding 18° during the day of the 5th, and falling to 1° at sunrise the next morning, being about the same as one of the coldest winter days at *Le*.

I had no personal experience of the winter at these heights, and the only information I can give on the subject is, that the lakes, elevated from 14,300 to 15,200 feet, are completely and strongly frozen over for three or four months in the year. As the freezing of large bodies of water is rather a sudden operation, following—not accompanying—the gradual depression of temperature, whilst the melting of the ice so formed is as gradual as the increase of temperature that causes it, the ice of the lakes is more nearly coincident with the calendric than the meteorological winter, or even later than the former. On the 5th of May, 1848, the ice was mostly gone from the *Tso Pangong*, elevated 14,300 feet, but several square miles of it, in a melting and discontinuous state, were still extant in parts of the lake, drifting about before the wind, and the shore was generally margined with large heaps of fragments four inches thick. On the 11th of the same month there were similar remains of ice on the *Tso-Rul*, at 14,400 feet, but they were of small extent and mostly melted when I repassed the lake on the 16th idem. Not a particle of ice was remaining on the *Tso-Moriri*, elevated 15,200 feet, by the 23rd of June, 1849, but the peasants of *Rupshu* reported that it had been frozen over during the past season for five months, viz. December to April (inclusive), and was safe for men and cattle over its whole extent for three of those months, viz. January to March. It must be noted that the first of these lakes is highly charged with salt, and the other two subsaline.

At elevations of 14,000 and 15,000 feet it begins to thaw by day in the end of April and beginning of May; and by the middle or end of the latter month the night frost becomes mild, and the day temperature rises to about 50°.

Regarding the temperature of the highest accessible elevations, my knowledge is confined to a few summer observations in crossing mountain passes; but the following inferences seem probable. At heights between 17,000 and 18,000 feet the temperature rises considerably above the freezing point during the day throughout the summer months: from 18,000 to 19,000 feet it thaws during the afternoon in July and August. At a height of 20,000 or 21,000 feet there is probably "perpetual congelation" in the shade; but the summer sun temperature must still rise above the freezing point to much greater elevations. In these situations the temperature of the air near the surface appears to remain below the freezing point until most of the snow is melted, the heat imparted by the sun being first absorbed in liquefying the snow.

Out of 26 observations, at as many different places, between 17,000 and 19,000 feet, the lowest temperature was 4°, at 11 A.M. 6th of November, 1848, at a height of 17,200 feet, in deep snow; this being the first permanent snow of the season, and the latest date at which I crossed a high snowy pass. In the earliest passage in spring, which was on the 22nd of April, 1848, I found the temperature 8° at 10 A.M., the height being 18,300 feet, and still covered with deep snow: at the latest in spring where I found deep recent snow, it was 12°, at 7 A.M. on the 13th of June, 1849, at a height of 18,800 feet: at the latest in autumn still free from snow, it was 26°, at noon on the 7th of October, 1847, at 18,400 feet. At the greatest attained elevation, which was 19,000 feet, the temperature was 30°, at 9 A.M. on the 11th of July, 1849, a little old snow still lying on the pass-top. The highest observed temperature was 55°, at noon on the 5th of August, 1848; but this was at the lowest elevation, 17,000 feet, and in a sheltered ravine bottom, on the S. side of a pass near 2,000 feet higher.

As I was not provided with proper radiating thermometers, my few Sun observations were not of much value; but one or two of the results may be worth stating. In 46 observations, from May to October, at heights ranging from 11,600 to 18,800 feet, a common thermometer with a plain unblackened bulb, rose when exposed to the sun, from 3° to 42° above the shade temperature shown by the same instrument nearly at the same time. In *Hanle Gunpa*, elevated 14,500 feet, from the 26th of September to the 6th of October 1847, 13 sun observations were made amidst the walls of the buildings, exposed to a great deal of reflected heat and sheltered from the wind, the weather at the time being generally very fine: under these circumstances the extreme observations were—

$$\text{At 10 A.M. 26th September} \left\{\begin{array}{ll}\text{Sun} & 80^\circ\\ \text{Shade} & 49^\circ\end{array}\right\} \text{difference } 31^\circ$$

$$\text{And at noon, 2nd October} \left\{\begin{array}{ll}\text{Sun} & 119^\circ\\ \text{Shade} & 41^\circ\end{array}\right\} \text{difference } 78^\circ$$

the sun temperature being above 100° in 10 cases out of 13.

In the same place, at noon of the 30th of September, the thermometer inadvertently left against a wall exposed to the sun was found at 145°, the shade temperature at the time being about 37°, and the boiling point of water 186¼°. And again, in the bed of the *Guge Sutluj* under *Tot-Ling*, elevated 12,400 feet, at noon of the 17th of July, 1849, the plain-bulb thermometer, laid upon a white felt on a rocky bank, with a N. aspect, rose in the sun to 140°; whilst the temperature of the air in the shade was 59°, of the river 55°, and of boiling water 190°.

The above, though not showing the true amount of the solar

radiation, sufficiently indicate that it is very great, and the fact is notorious in the personal experience of all travellers in these regions. This heat of the sun's rays compensates, to a certain extent, for the deficiency of atmospheric warmth in these elevated regions, and forms a most important element in the process of vegetation, without which much of the Tibetan agriculture would be impossible.

In the winter of 1848-9 I made an attempt to ascertain the temperature of the earth at the foot of *Le* town, with the idea of obtaining a constant temperature indicative of the mean temperature of the place; but the attempt was unsuccessful, either from want of proper thermometric apparatus, or because it was impossible, with the tools and workmen forthcoming, to attain any depth without making a hole so wide as to admit some of the changes of temperature in the air above. My well was sunk to a depth of 36 feet, and was 3 or 4 feet in diameter; the soil was the common alluvial deposit of granitic gravel, and at the bottom a little moist but not wet. The temperatures at the bottom were—

At 11 A.M. 27th December	1848, 51°,	air above being	24°
At 9 A.M. 28th December	1848, 46°,	do.	24°
At 8 A.M. 24th January	1849, 43°,	do.	18°
At 8 A.M. 25th March	1849, 38°,	do.	34°

which look as though the temperature of the upper air gradually found its way to the bottom of the well during the three months.

I also once or twice noted the temperature of the earth freshly extracted from a narrow bore, which could only be got to the depth of 3 or 4 feet; it was

At 9 A.M. 28th December	1848, from 3 feet, 33°,	air being	24°
At $2\frac{1}{2}$ P.M. 23rd January	1849, from 4 feet, 37°,	do.	30°
At 6 P.M. 24th March	1849, from 3 feet, 40°,	do.	42°

from which it may be inferred, that in these regions the earth is not frozen below the surface, even in mid-winter, in localities so warm as Le, or generally up to heights of 11,000 feet.

In August, 1848, I made similar attempts to bore for subterranean temperatures at a height of 14,800 feet, at *Phoprang* of *Pangong*, but they were totally frustrated by water at a depth of 3 or 4 feet, the site being in a narrow valley-bottom saturated by a large rivulet, and the contiguous hills too stony for the available means of excavation.

In the absence of accurate determinations, some estimate of the mean temperature of Central *Ladak* may be better than nothing: I therefore add the following as probable approximations:—

Central *Ladak*, in lat 34° N. at 12,000 feet	Coldest month, January	from − 5° to + 25°	Mean 10° Fahr.
	Warmest month, July	from + 50° to + 70°	Mean 60° do.
	Mean of the year		35° do.

But the mean temperature of *Le* is probably 38°, having an advantage of site amounting to 2° or 3°, and assimilating its climate to other places less warmly situated at an elevation of 11,000 feet.

The height of freezing mean temperature may be reckoned probably about 13,000 feet.

Barometric Pressure.—The few barometric observations that I was able to make at fixed stations, tend to show that the atmospheric pressure is subject to the same sort of fluctuations on the Tibetan table-land, even at great heights, as prevail in the lower regions elsewhere.

At *Hanle* in the *Changtang* of *Ladak*, at an elevation of 14,400 feet. the daily tides occurred during 17 days of the end of September and beginning of October 1847, about the usual hours, viz., 9 A.M. for the maximum and 4 P.M. for the minimum, and their mean amount during that period was nearly ·09, the average pressure being about 17·8. At a station in the town of *Le*, elevated 12,000 feet, during 14 days of the end of November and beginning of December, 1847, the tides obtained at the same hours and averaged the same amount. In the latter case the pressure fluctuated between 19·31 and 19·77, showing an irregular variation of ·46, or nearly half an inch in a fortnight; but these limits seem to have included the whole amount of the ordinary fluctuation; for during 18 months over which my observations extended at the same place (though by no means continuously), the highest and lowest boiling points of water (out of 17 observations) were 191·45 (at 11 A.M. 24th November, 1848) and 190·30 (at 5 P.M. 17th April, 1848), which corresponded exactly (on the scale of my thermometer) to the barometric extremes above stated.

The irregular variations of pressure seem to be connected in these regions, as elsewhere, with calm and fair weather in the case of high pressure, and wind and moisture when low. My observations were not sufficient to establish any of the regular annual movements of the barometer.

Winds.—In a country formed like West *Nari*, of narrow passages between walls of steep mountain, variously arranged and connected, any single aërial current uniformly impelled from one quarter, must, in all probability, become subdivided into a great variety of local currents, sometimes so altered in force or direction as to be annihilated or diametrically inverted. The complexities of such a system cannot be explained by any off-hand or partial observations of a mere traveller; and what little I say on the subject must be taken with a sufficient margin of doubt.

The total amount of wind in the year is perhaps more moderate than travellers from warmer regions, exposed in tents, are apt to suppose. Winter is the season of least wind. In Central *Ladak*

a good deal of high W. wind prevails in spring. Strong S. winds blow during the summer in the southernmost districts of *Ladak* and *Nari-Khorsum*, or those next to the Indian *Himalaya:* they are especially remarkable on the southern confines of *Guge*, *Kangri* and *Purang*, and in exposed situations often very violent. The force of the wind is greatest in the afternoon, or warmest part of the day, the nights and mornings being usually calm. The prevailing direction of the wind in *Ladak* appears to be W. or N.W., blowing up the valley of the *Indus;* but in open places of the *Changtang* I have sometimes observed a diurnal veering, the wind changing its direction so as to blow from the apparent place of the sun, or easterly in the morning, southerly at noon, and westerly in the evening.

Clouds.—The climate of *Ladak* is sufficiently fine as regards the proportion of sunny to cloudy weather. During two years, I found the number of days on which sunshine predominated, to be nearly as three to two compared with those on which clouds prevailed; the former including perhaps half the number of days (or nearly a third of the whole year) on which the weather was intensely fine, sometimes with a perfectly cloudless sky, and the latter an equal proportion, or about a fifth part of the year, of very dull or gloomy weather. Foul weather, that is actual rain or snow, during the daytime is of very rare occurrence—in the valleys at least, though the mountain tops may experience a good deal more of it.

Winter is the season of clouds; the number of cloudy days in this quarter considerably exceeding the fine ones; in spring they are nearly equal, in summer the sunny weather greatly exceeds the cloudy; and in autumn the sunshine still predominates, in a less degree.

By far the commonest form of cloud is a cirrus, of a hazy and indefinite sort; cumulus may be seen, but rarely, in summer. The nimbus, as seen in the lower regions, is almost unknown here, or faintly approached in midsummer, and seldom perfected to the production of a few drops of rain. The discharge of snow at all other seasons results from a thin misty cloud, formed by insensible gradations from the cirrus, condensed and lowered to the surface of the earth; the descent of such quasi-nimbus into the valleys as low as Central *Ladak*, or 11,000 feet, during the daytime, occurring only twice or thrice in the course of a whole winter, and never at any other season.

The statements here made must not be applied very strictly to the southernmost parts of the country, as they partake, in a slight degree, of the clouds and mists of the Indian *Himalaya*.

Moisture.—I have no wet-bulb or dew-point observations from which to discuss the minutiæ of this subject; but I kept a careful

account of all precipitations of moisture susceptible of measurement by rough means, which affords some idea of the extraordinary dryness of the climate of *Ladak*.

It appears from these that, on the average of two years, there were 31 measurable falls of snow in the year, descending to the inhabited valleys at heights of 12,000 feet and upwards, besides 18 falls of snow on the mountain-tops out of reach, and 4 showers of rain too scanty to be measured—in all 53 precipitations of moisture in the year.

The 31 measured falls of snow amounted only to 20¼ inches, and though this amount may have lost a little sometimes by melting before I could effect my measurement, it includes many falls which covered the ground so thinly that they could not be measured (by ordinary means), and were therefore estimated at the twentieth part of an inch each.

The greatest continuous snow was at *Himis Gumpa*, elevated 12,500 feet, from the 23rd to the 25th of April, 1849, and amounted to 8 inches, which in these accounts however I have divided into 5 falls, as it occupied three nights and two days. The annual mean of one fall (within 12 hours, *i. e.*) was only two-thirds of an inch.

The distribution of the snow through the seasons is thus:—Nearly the whole of it in the winter and spring, and this almost equally divided between the two seasons in aggregate quantity; but as regards frequency, there were nearly three falls in the winter to two in the spring, so that the former averaged little more than ½ an inch, while the latter exceeded ¾. In winter the greatest fall in 12 hours was only 2 inches, viz. at *Le*, 12,000 feet, on the night of the 5th-6th of February, 1848; in spring it was 4 inches, at *Erat* of *Tanktse*, 14,000 feet, on the night of the 23rd-24th of May, 1848.

The only summer fall that came under my observation occurred in the earliest part of that season, viz. the 8th and 9th of June, 1849, and in the southernmost part of *Zangskar* close to the Indian *Himalaya*, so that it is rather an anomalous item as regards the climate of Central *Ladak*. Half of all the snow-falls observed on the mountain tops out of reach, occurred in the single season of autumn. In Central *Ladak* little or no snow appears to fall for three months of the year, coincident with the calendric rather than the meteorological summer: and this season may be reckoned safe for crossing the highest passes up to 19,500 feet, but on Indian passes the traveller may be buried in snow, even below 17,000 feet, at the autumnal equinox.

Snow during the daytime is unusual, by far the greater number of falls occurring between midnight and sunrise, or at the coldest part of the 24 hours; a remarkable proof this of excessive dryness.

The rain that came under my observation was confined to the summer: excepting one fall in *Zangskar*, on the very last day of spring (at *sTongde*, 11,900 feet, 31st of May, 1849), and which turned to snow at night; its quantity was contemptible; and, speaking approximately, one may say that it never rains in *Ladak*. Allowing for imperfect measurements, and falls not susceptible of measure, the total amount of moisture precipitated in the year may be reckoned about 2 feet of snow, which is equivalent I believe to only 3 or 4 inches of rain. This refers particularly to elevations about 12,000 feet, and to Central *Ladak*: at superior elevations the fall of snow is probably greater, and I more than once found it lying 2 or 3 feet deep on mountain passes, between 17,000 and 19,000 feet.

In the *Lhogyut* the climate is generally moister, and the quantity of snow very much greater, than in the *Zhunglam;* and the *Changyut* again more dry and snowless than the *Zhunglam*. This is a general effect, depending on proximity to the moisture of India or to the aridity of Central Asia. A local cause of such differences is to be found in the relative height and density of the mountain masses, which are the great collectors of cloud and snow; and in the *Changtang* accordingly there is less snow than in the *Rong*. Hence the excess of snow in *Zangskar* and *Purik*, compared with *Ladak* proper and *Nubra;* and in *Purang* and *Kangri* compared with *Guge* and *Gar;* the moderation of snow in *Rupshu* and in *Guge*, though belonging to the *Lhogyut;* and the snowless waterless sterility of *Ruduk*.

The snow of *Ladak* is remarkable for its form as well as its small quantity. Instead of the large crystallized flakes familiar to English experience, it generally falls in minute granules, somewhat globular, and not obviously crystalline. This seems to be the joint effect of low temperature and rarified atmosphere, and analogous to the fine drizzling rain in the higher regions of the Indian *Himalaya*. The form becomes much more flaky and crystalline in the falls of spring at higher temperatures.

Dew, hoar-frost or frozen dew, and hail are, I believe, unknown, unless in immediate proximity with the Indian *Himalaya*.

Electricity.—The total absence of thunder and lightning in *Ladak* is most remarkable, and appears to be dependent on the excessive dryness of the climate. In two years I twice heard a very faint roll of thunder, accompanied by clouds, and a few drops of rain; and once, close upon the borders of the Indian *Himalaya*, I saw the gleaming of distant lightning, that seemed to belong to some great thunderstorm far on the Indian side of the mountains: all these were in the middle of summer. In winter the increased dryness of the air deprives it of its electrical conduction to such an extent, that the human body, cased in sheep-skins, becomes charged

so strongly sometimes, as, on touching a conducting object, to give off large sparks, with a shock that may be felt through the joints of the fingers.

Snow Line.—Immediately connected with the subject of climate is this "vexata questio:" indeed the snow-line of a country may be regarded as an index of its joint thermometric and hygrometric status, and of their mutual reaction. The hygrometric element has often been too much overlooked, partly, no doubt, because it was comparatively unknown; but the preceding observations on the precipitations of moisture in *Ladak* may assist in dispelling these errors of omission, and my brother Richard has already given the necessary theoretical explanations in his memoir on the snow-line of the Indian *Himalaya.* From a series of minute observations on the snow level made during two years, in the course of which I crossed 25 passes, elevated from 15,000 to 19,000 feet, at various seasons, between the end of April and beginning of November, I have arrived at the following conclusions:—

The snow-line in the central and northern parts of West *Nari* attains an extreme height of nearly 20,000 feet. It lowers on approaching the Indian *Himalaya*, and on the southernmost parts of the Indian watershed descends perhaps so low as 18,000 feet. In the *Changiang*, or any districts not in the *Lhogyut* where they are under 20,000 feet, the mountains will be almost entirely denuded of snow during the latter part of summer.

The snow curve appears to culminate about the middle of September, and its season of greatest elevation to be later even than the calendric summer. Its depression by fresh falls in autumn is very gradual in the central and northern zones, so that heights of 18,000 feet may be found free of snow in the middle of October, whereas on the Indian watershed the snow line often descends before the end of September several thousand feet in a few days.

I am not able to define the minimum limit of snow in West *Nari*, because my winter residence lay altogether above it, and out of all sight or cognizance of it, but I doubt whether any part of *Balti*, *i. e.* down to 4,500 feet, can be below the reach of winter snow in ordinary seasons.

It is also probable that the snow which survives the heat of summer above 20,000 feet, does not retain its original form, but is mostly converted to nevée before its renovation by the falls of autumn, and that this effect extends even to the tops of the highest mountains of the central and northern regions.

The snow-line is, of course, generally lower on the N. exposures than on the S. The difference appears to be least, and then hardly appreciable, soon after heavy falls; when the melting has made some progress it sometimes exceeds 1,000 feet.

In these statements I consider the Snow-line as that average level where the surface of snow is equal to the surface denuded by melting (and not merely by precipitous formation of the mountains). The estimates themselves (made from heights determined by the boiling thermometer) are attended with some uncertainty—to the amount perhaps of 500 feet; for though the hypsometric data on which they rest are probably correct within one or two hundred feet, the process of judging by the eye, whether the snow upon one's path, and still more upon the contiguous mountain sides above one's actual station, begins to exceed the bare spaces, or *vice versâ*, is neither easy nor susceptible of much exactness.

II.—*A Sketch of the Geography of Borneo.* By John Craufurd, Esq., F.R.S., &c.

Read May 10, 1852.

The natives of Borneo, of whatever description, have no name, or, at least, no popular and well-known name, for it. This is, indeed, the case with all the natives of the Archipelago to which it belongs, in so far as concerns all the greater islands, with, perhaps, the single exception of Java. What they call "an island" (pulo), is no more than an islet, an object, of which the insularity is palpable, almost to the eyesight. This is quite consistent with their narrow knowledge and their limited powers of comprehension and generalization. They may be said to view the great islands as so many continents, and, generally, call the different portions of them by the names of the natives which inhabit them. Borneo has, however, by a few Malayan scholars, been sometimes called Pulo Kalamantan, or the Island of Kalamantan, but it is a name which occurs only in romance; and although it has the form of an abstract noun, I have not been able to assign any meaning to it, or to trace its origin. The European name is obviously enough taken from that of the town and state of Borneo Proper, which is variously written and pronounced by various Malay tribes as Brunai, Brune, Burnai, and Burne. Pigafetta, and the companions of Magellan, visited it in 1521, and were the first Europeans that did so. He at once applies the name, which he writes "Burne," not only to the town and country, but to the whole island; and informs us that it is so large, that it takes "three months to sail round it." One only wonders, by whom Pigafetta was informed of its insularity. To him, however, must be inscribed the name which the island has ever since borne.

The equator bisects Borneo, leaving something like one-half of

its surface within the northern, and one-half within the southern hemisphere; about 4° of it in its broadest part being in the latter, and 7° in its narrowest in the former. The most western portion of it is about 110° east of London, and the most easterly about 120°. Its shape is that of a shoulder of mutton, the broadest part to the west, and the narrowest to the east. The area of Borneo has been variously computed at from 286,000 to 360,000 square miles, and probably it is equal to about eight times the size of Java—a single province of which is more valuable. It may be about thrice the size of the two British Islands, of which some single counties far exceed it in population.

Borneo has a coast line of some 2000 miles, which is about the breadth of the Atlantic between Ireland and the nearest point of the continent of America. That line has few bays, and no deep inlets of the sea, which would throw the several portions of the island into communication. On the contrary, it is a great unbroken dense mass of land, much like a huge piece cut out of tropical Africa. Portions of the interior must lie at least 300 miles from the sea, for the greatest length of the island is 850, and its greatest breadth 680 miles.

Of the mountains of Borneo we know very little. The ordinary height of the highest one on the eastern side seems to be from 1000 to 1200 feet above the level of the sea; but Kinibalu, towards the northern part of the island, has been estimated at from 13,000 to 14,000 feet (13,698). It does not appear, however, that, with this exception, there are any others of the great elevation of those of the volcanic islands of Sumatra, Java, Bali, or Lomboc, that is, rising to the height of from 10,000 to 15,000 feet. There are, probably, many considerable lakes in a country of such vast extent, and two of them have been ascertained and named. The lake of Kinibalu, which, however, no European has visited, and of which even the very existence is not certain, is said to lie to the northern portion of the island, at the foot of the mountain of the same name, and is reputed to be 100 miles long. The second lake, called Danau Malayu, or the "Malay Lake," was first visited by Europeans in 1823, and found to be 8 leagues in length by 4 in breadth, with a depth of 18 feet in some parts. It is situated in 1° 5′ N. lat., and 114° 20′ E. long., and is 45 leagues from the western coast. The rivers are of considerable length, but every one obstructed by a bar at its entrance. On the western side of the island, the principal ones are those of Sambas, Pontianak, Matan, Sukadana, and Mampawa. These have bars, on which, at high water and spring-tides, there are from 6 feet at the lowest, to 15 feet at the highest, so that they are all navigable only to small vessels, and to these with inconvenience. On crossing the bars there is abundant depth up to certain falls, said to be 30

feet in height. On the southern side of the island the principal rivers are those of Banjarmasin, Pasir, and Kuti; the last may be taken as a sample. The traveller Dalton states, that he ascended it for 600 miles, reckoning by its winding, and found it with a good depth of water, and a breadth ranging from 400 yards to a mile. The principal rivers of the north-western coast are the Sarawak, the Sarebas, the Rejang, the Kayan, the Bintulu, and the Brune, or Borneo. The last is the largest and most important of these; but even this is of intricate navigation, and not practicable for vessels drawing above 15 feet of water for more than 20 miles up.

As to climate, it is evident enough what that of Borneo must be when the equator bisects it—when it is surrounded by the sea—when it is remote from any continent—and when all the monsoons which blow in the Indian Ocean pass over it. That portion of the island which lies N. of the equator, is subject to the monsoons of the northern Indian Ocean, or the S.W. and N.E.; and that which lies S. of the line, to the monsoons of the Java Sea, or the N.W. and S.E. The climate is damp and sultry, the thermometer at the level of the sea seldom falling below 80°, or rising above 90°. The whole island is one huge primeval forest, from the water's edge to as far in the interior as it has been penetrated by Europeans; and the cleared land would seem to consist of mere spots, few and far between. Mr. Dalton, already quoted, gives a very graphic account of this state of things when he is describing a village or town on the banks of the river of Kuti: "The country behind," says he, "is a complete jungle down to the water's edge (here and there are to be seen rice and sugar fields); it would be totally impossible for five men to move abreast of each other only for a few yards, so close and impenetrable is the jungle. The inhabitants never think of cutting or clearing away the trees or long grass around their houses, so that within 10 yards of the best habitations the wild wood is as thick as in the most unfrequented parts." With all this, I have never heard that any portion of the island has been charged with peculiar insalubrity, although to the European constitution it must be both uncomfortable and debilitating.

The coast of Borneo would be a dangerous one to navigation, from the absence of the shelter of harbours, of which it can hardly be said to have any, if it did not lie in the latitudes exempt from the storms and typhoons which prevail in the northern part of the China Sea, and which, although they extend to the Philippine group, never reach it. Heavy squalls are experienced at the changes of the monsoons, but this is all.

The geological formation of so vast a country as Borneo must of course present great variety. As yet, primary and secondary

formations only have been found; and of the volcanic formation, so prevalent from Sumatra to the Moluccas, no trace has been discovered. Certainly no volcano in a state either of activity or quiescence has been seen; and, indeed, the island lies out of the course of the well-known volcanic zone of the Archipelago. The mineral wealth of Borneo, however, is remarkable, and in this respect, probably, no country of the East is equal to it. The following are the minerals which have been ascertained to exist in abundance, and to be worth working, viz., coal, iron, antimony, gold, and diamonds: indications of tin and copper have been reported.

The coal was discovered about ten years ago, within the territory of Borneo Proper, and close to the sea, the fields appearing to extend about 20 miles along the river of Brune, and cropping out again in the British island of Labuan. In this last place about 10,000 tons have been already raised and used for steam navigation, for which its quality has been found superior to that of any Indian coal. An English company with British capital and skilled labour is engaged in the mining. On the southern coast the Dutch have found coal, which they are at present engaged in mining.

Iron ore abounds in many parts of Borneo; and to judge by the excellence of the raw iron, tools, and weapons made of it, even by the rude industry of the wild natives, it must be of very superior quality. Everywhere these people are acquainted with the art of making good malleable iron, which is held in such estimation, that it forms an article of exportation. For the market it is made up into little faggots of ten pieces, each 9 inches long, $1\frac{1}{2}$ broad, and $\frac{1}{4}$ inch thick. "It is of superior quality," says a writer in Moore's 'Indian Archipelago,' "as tools made of it are not steeled; and is in great demand among the natives." He adds that, it is sold by retail at the enormous price of 55*l.* a ton. Mr. Dalton's testimony, given from another part of the island, the southern coast, is to the same effect. "The iron," says he, "found all along the coast of Borneo, is of very superior quality. They (the Dyaks) have a method of working it which precludes the necessity of purchasing European steel, except for cock's spurs, which they prefer when made of a razor. I have counted 49 forges at work merely in the kampung (village) of Marpow. Instruments made of it will cut through over-wrought iron and common steel with ease. I have had several penknives cut with them by way of experiment; and one day having bet a wager of a few rupees with Selgie (the Dyak chief with whom he was living) that he would not cut through an old musket barrel, he, without hesitation, put the end of it on a block of wood and chopped it to pieces, without in the least turning the edge of his mandaw (cutlass)."

I venture to conjecture, that much of the fine quality of wrought iron depends more on the superiority of the ore from which it is made, than on the skill of the wild manufacturers. If this be so, and the ore, as alleged, abundant and accessible, it might, I imagine, be advantageously exported to this country, as dead weight, as the ore of antimony of the same country now is. It is said to abound at Bintulu, near the locality of abundant sulphuret of antimony; and as this, with a navigable river, is within 100 miles of the British settlement of Labuan, it might be conveyed thither by the native craft of the country, and stored to ballast European shipping.

On the western side of Borneo diamond mines have been long worked, and the formation in which diamonds are found extends over a very wide space. The principal workings, however, are in the district of Landak, in about 2° north of the equator. The deepest boring, which is made in order to reach the stratum which contains the diamonds, is from 50 to 60 feet, and, when such is the case, the different strata passed through are the following: black mould, 3 feet; yellow sandy clay, 17; red-coloured clay, 17; tenacious slate-coloured clay, mixed with large stones, 6 to 7 feet; a similarly-coloured clay, with small pebbles, and called by the Malays ampir, which is the preposition "near, or at hand," and considered a sure indication of the vicinity of diamonds, also from 6 to 7 feet; and, finally, a tenacious yellow clay, from 6 to 7 feet. After this comes the stratum containing the diamonds, a yellowish gravelly earth with an admixture of pebbles of various sizes and shapes. This matrix of the diamond, ranging from 3 to 10 feet in thickness, goes under the name of areng, a word the literal meaning of which I do not know, but in ordinary Malay language, it is the adjective "fetid," and if it be this, the term has probably some reference to this quality of the stratum. It often happens, however, that the stratum containing the diamonds is found at a much smaller depth than the 50 or 60 feet now mentioned.

The diamond mines are worked by the aboriginal inhabitants, by the Malays, and by the Chinese,—by the two first in the following very primitive, very tedious, expensive, and dangerous manner. They dig a pit, barely equal to the admission of the body of the workman, and not exceeding 2 feet in diameter, until they reach the areng, or diamond stratum, and then, pushing a lateral shaft, gather the earth, and hoist it in small baskets to the surface, when it is washed in little wooden platters at the nearest stream, until nothing remains but the pebbles, which are then carefully examined for the diamonds. In these operations many accidents occur from the neglect of the miners to prop the shafts. The Chinese proceed more artistically. They seldom open new

mines, but availing themselves of those abandoned by the Dyaks and Malays, when they are in favourable situations, direct a stream of running water on the upper strata, to carry them off, until they reach the diamond matrix, which is collected and washed in wooden troughs by a stream of water, until all the soil is washed away, when the residuum is examined for the diamonds.

The diamonds are a profitless monopoly purchased by the Dutch Government many years ago for 50,000 Spanish dollars, or about 10,000*l.* The quantity of diamonds extracted from the Borneo mines in 1824, or, rather, the quantity *bonâ fide* delivered to the Government, was 1900 carats. The quantity, however, which the mines are capable of producing seems to have no other limit, than that of the capital applied to mining for them, and the Dutch Government appears to apply very little. Private enterprise alone is suited to such undertakings. The largest diamond known to have been taken from them in recent times weighed 36 carats, but the Malay Raja, of Matan, is in possession of a rough diamond got from them weighing 367 carats. Some doubts, however, have been lately thrown on the genuineness of this gem. Supposing it, however, to be a true diamond, it would afford to lose 88 grains in cutting into a brilliant, and still equal in size the Koh-i-noor, according to Tavernier's estimate of the weight of the latter. Dr. Leyden, according to the old manner of estimation, values it at 365,378*l.*, but it is certain, that he has omitted to deduct the loss of weight it would sustain in cutting.

Gold is found on the western side of Borneo in various situations over near 5° of latitude extending across the Equator, the touch, or fineness, varying at each locality from 18 to 21 carats. It is all the produce of washings, and the processes are similar to those pursued in the diamond mines, the Chinese being the principal diggers. Of the produce there are no reliable statements. Those which have been made are mere estimates. Sir Stamford Raffles about 40 years ago made it about 1,000,000*l.* a year, and even now it is probable that it does not exceed this amount.

Antimony was discovered to be an abundant product of Borneo in 1825, and then by mere accident. A person, strolling through the market of Singapore, picked up a mass of it, and found, not by his skill in mineralogy, for he had none, but by the use to which it was put, the enhancing of the brilliancy of the women's eyes by applying it as a cosmetic to the edges of the eye-lids, that it was a sulphuret of antimony. The history given by the native shop-keeper, with whom the mineral was found, was this. Small quantities used to be imported from the ports on the Persian Gulf, which served the Malays of the neighbourhood for years, and then the price used to be about 70 dollars the picul of 133 lbs.; but a year before a native trader of Borneo had imported a quantity of it

as ballast to his prau, and the price fell at once to 9 dollars. The place, from which the ore was introduced, was ascertained to be Sarawak in Borneo. A portion of the ore was smelted in the presence of the principal Chinese merchants; an account of the discovery was published in the local newspaper—the native traders were encouraged to import it, and the European merchants to send it to England as dead weight. The trade was at once established, and now there is yearly imported into this country about 1000 tons of the antimony ore of Borneo, which forms the principal supply of the kingdom. I was myself in charge at the time alluded to of the civil administration of Singapore, and was, in fact, the person, that strolling in the market-place lighted on the mass of sulphuret of antimony, caused it to be smelted, and published an account of it. Recently antimony has been discovered at Bintulu between the 3rd and 4th degree of north latitude, as already alluded to.

The native vegetable products of Borneo, which are put to economical purposes, are, a considerable number of useful timber-trees, not however including the teak, which no country of the Eastern Islands except Java, and Mindano, one of the Philippines, produces; Malay camphor, the produce of the Dryobalanops camphora, and which, for its supposed tonic virtue, the Chinese purchase at more than its weight in silver; camphor oil from the same tree, a cheap and abundant product; raw sago, a large export for the manufacture of pearl and meal sago at Singapore, with ratans and canes.

The larger animals of the forest of Borneo are a species of wild ox, seemingly the same that is found in Java (*Bos sundaicus*), and the hog, or wild boar (*Sus verrucosa*), with a species of leopard, and some deer. Whether the elephant exists or not is still doubtful. If it does, it is certainly confined to the south-eastern promontory of the island called Unsang. Pigafetta and his companions in 1521 were conveyed on elephants, probably, however, of foreign importation, to the presence of the Sultan of Borneo; and if elephants, as the natives state, do exist, they may possibly be the offspring of these foreigners run wild.* I believe the rhinoceros has not been found, and the royal tiger certainly has not, which is remarkable, since it is so abundant in the Malay peninsula, Java, and Sumatra. The animal products of the land or seas of Borneo employed for economical uses are:—beeswax, esculent swallow-nests of an inferior quality, bezoar stones—called in the Malay language goliga, and alleged by the wild people, who collect them, to be extracted from the flesh of the porcupine—and of some species of

* Since this paper was written a native had imported into the settlement of Labuan a quantity of large elephant tusks from the peninsula of Unsang, the very spot in which the natives had described elephants as existing.

simiæ, the result of wounds inflicted by other animals, and not, as generally believed, extracted from the stomachs of ruminating animals; with tortoiseshell, and the tripang, sea-slug, or holothurion.

Borneo is inhabited by four descriptions of people—the aboriginal inhabitants, the Malays, the Chinese, and the Bugis of Celebes. The first of these are the most numerous, and from the singularity of their manners best worth a detailed account. They are well described by the traveller, Mr. Dalton, already named, as they exist on the south coast of the island, and again by Mr. Burns, a grandson, by the way, of the great poet and ploughman.* Both these gentlemen lived for some months among them, and Mr. Burns not only acquired a knowledge of the language of the most potent of the aboriginal tribes, but married the daughter of one of their chiefs.

The aborigines of Borneo have no native name by which they distinguish themselves in the aggregate, but each tribe commonly takes the name of the principal river on which lies its chief residence. The Malays call them all Dyak, a word equivalent to our own term "savage" or wild man, and apply the term equally to the wild tribes of Sumatra and Celebes, as to those of Borneo. To distinguish one tribe from another, they add to the general term the name of the tribe's chief river, as Dyak Kayan, "the savages of the Kayan," Dyak Sakaran, "the savages of the Sakaran," &c. &c. The aborigines of Borneo are of the same race of men as the Malays and Javanese—are, in fact, these people rude, uncivilised, and in the infancy of society, just as the Silures of Agricola are the civilised Welsh of our times. The Dyaks of Borneo are divided into probably not fewer than a hundred different tribes or nations speaking as many different tongues. This is tropical Africa, or tropical America all over, and a sure indication of a low state of society. All the tribes, however, are by no means in an equally abject condition, for while some are mere naked hunters, without fixed habitations, and wandering through the forest in quest of a precarious subsistence, the majority have fixed abodes and have made some progress in the useful arts.

The most advanced and powerful of the Dyaks is the nation of the Kayan, whose territory extends across the island for about 3° on each side of the equator. The Kayans are not a wandering tribe, but dwell in permanent villages, and substantial well constructed houses of wood with shingled roofs. They grow rice, the batata, the sugar-cane, the banana, the pine-apple, and tobacco. They cultivate, however, no textile material, and are unacquainted

* Since murdered by robbers or pirates of the Sulu islands.

with the art of weaving, being clothed in the bark of trees, and of late in foreign fabrics, chiefly the produce of the power-looms of Manchester. Some other tribes, however, cultivate cotton, and have acquired the art of weaving.

The common fowl, the hog, and the dog, are the only animals they have domesticated, having no beast for draught or burden. Their skill in forging iron has been already mentioned. The aboriginal inhabitants of Borneo have no knowledge of letters. They never invented an alphabet, and Borneo is the only great island of the Archipelago inhabited by the Malayan race in which this feat has not been accomplished. In most respects they may be described as below the ancient Britons as depicted by Cæsar.

Some of the customs of the Dyaks are extremely barbarous, and of these the most remarkable is the hoarding of the heads of enemies or strangers, whom they waylay and murder in order to possess themselves of these much valued treasures. The practice is nearly general among all the tribes of Dyaks throughout the island, but is only less inveterately pursued by some than by others. Mr. Dalton gives the following very graphic account of the head hunting and the marriage, which is the reward of a successful *battue*:—

"No Dyak can marry the daughter of a warrior, unless he has previously taken a head or two. Neither will one of the great chiefs allow a marriage with one of inferior celebrity. On a proposition being made to wed, it is referred to the Rajah, who calls before him the lover and the father of the girl; the former is asked what number of heads he has taken; the same question is put to the father; if the old man can produce ten heads, the young one must have five, as, according to Selgie's reasoning, by the time the lover is of the age of the girl's father he will, in all probability, be likewise in possession of ten. Should the young man not have so many, he must get them before he presumes to take another step in the affair. He then musters a few friends, takes a swift boat, and leaves that part of the country, and will not return until the number is complete (they are often absent three months). To return unsuccessful would expose him to ridicule ever after. Women's heads will not answer the purpose; they, however, generally bring back with them a few young women, and some children as an acceptable present to the Rajah and to attend the wife. They wend their way to some unprotected campong (village), taking advantage of the absence of the young men, and kill the old ones, or some poor straggling fishermen; it makes no difference whose heads they may be, so they do not belong to the Rajah's friendly campongs. Having procured the desired number, they paddle quickly back and send immediate intelligence to the intended bride, who puts on all her ornaments, and with her father and friends advance to meet the heads; these are in the first instance always placed on a spot about half-way between the dwelling places of the two partners, and near the Rajah's house. On the approach of the young lady, the lover meets her with a head in each hand, holding them by the hair; these she takes from him, and he gets others if there are sufficient, if not, they have one each. They then dance round each other with most extravagant gestures amidst the applause of the Rajah and his people. After this ceremony, the Rajah, or some warrior of his family must examine the heads to see that they are fresh; for this purpose they are not allowed to be smoked or the brains taken out, which destroys the smell, but must bring them in a green state, in full proof

that old heads have not been borrowed for the occasion; (I have frequently seen heads which have been cut off a week or more, the smell of which to me was intolerable, but to them nowise offensive). The family honour of the bride's father being now satisfied, he asks the Rajah's consent, which is always given (the young women and children taken during the expedition are at this interview presented). A feast is now prepared, at which the young couple eat together; this being concluded, what clothes either of them may have on are taken off, and sitting on the ground naked the old women throw over them handfulls of paddy, repeating a kind of prayer that the young couple may prove as fruitful as that grain. At night the bride attends her husband to his dwelling."

Mr. Dalton describes the funeral ceremonies of the Dyaks as follows:—

"The burials of these people are not less singular than their marriages. The old men have every attention paid them whilst living, and indeed long after they die. On the death of a chief or rajah, they dress him out in his war habiliments, and carry him to the grave (after keeping him in the house a certain time according to his rank, seldom longer than ten days) on a large litter enveloped in white cloth; they lay the body in a place prepared, without a coffin; by his side are deposited his arms, particularly his shield, spear, and mandow; a quantity of rice and fruit are likewise enclosed with other such articles of food as the deceased was most partial to; the grave is then closed up; a high mound raised, and this is encircled with strong bamboo, upon which fresh heads are placed as the most acceptable offering to the deceased. No warrior would dare to appear before the family of the chief without, at least, one head as a consolatory present; these are thickly studded round the grave, and occasionally renewed during the first year or two, the old ones being considered the property of the succeeding chief."

With respect to religion, the Dyaks have neither priests, nor temples, nor do they pray or fast. The storing of human heads, may indeed, be considered as a kind of sacrifice, and now and then, on remarkable occasions, it seems they sacrifice a human victim, and even partake of the flesh, the party being a slave bought for the purpose.

"I cannot ascertain," says Mr. Dalton, "that the Dyaks have any religion amongst themselves, or entertain an idea of future rewards and punishments." But he adds, "It is, however, most certain, they have some idea of a future state; this not only appears in their funerals, but on other occasions."

Although, as might well be expected, the Dyaks have no regular system of religious belief, they have many strange superstitions. Like many other nations, they draw omens from the flight or sight of birds, and consider some birds of good, and others of ill omen. Both Mr. Burns and Mr. Dalton testify to this fact. The latter tells us that of encountering a certain bird, they have the greatest dread.

"There is a certain bird of which they stand in great awe; when they hear the note of this bird, no inducement can urge them further on the same line of road. I have frequently been out shooting when we heard it; on such occasions they invariably would stop and tremble violently, and immediately take another road. I never could obtain a sight of this bird of ill omen, for such it is considered; if I attempted to advance a single step nearer the sound, they took hold of me and pointing towards the sky with gestures of apprehension,

forced me a contrary way. The notes are very similar to those of our blackbird, equally sweet, but much stronger. Notwithstanding my becoming brother of the great Rajah, I always entertained an impression that I should be murdered, if by mischance I happened to shoot one of these birds. It is evidently a superstitious feeling, this particular bird being looked upon as an evil genius."

There is one strange custom which is well authenticated. It exists over the whole island of Borneo, and is practised by tribes however far from or unknown to each other. According to Mr. Dalton,—

"The Dyaks do not circumcise, neither can any inducement urge them to submit to the operation." . . . "Quanquam præputii abscissionem aversantur, mos inter eos usurpatur mirabilis adeo ut vix credi possit. Penis glandem metalli filo decussatim transfigunt. Fere omnes Selgici hoc modo perforati sunt. Ritus non sine vitæ discrimine acerrimum dolorem incutit, totiusque gentis tertiam partem perdit. Filum acuminatum per mediam glandem vi transmissum abscinditur, et iterum transverse inseritur. Quatuor apices deinde ita limantur, ut cutem octavâ pollicis parte superent. Sunt quidam ad hanc artem destinati, quibus adolescentes nondum puberes committantur. Rajahæ filis utuntur aureis, principes autem, cæterique ditiores, argenteis. Plerique tamen, septem decimæ scilicet, inopiæ causâ, cupreis utuntur. Quinetiam plurimos et ipse vidi, qui non vel cupri tantulum emere valerent. His arundinis Indicæ, *Bamboo* dictæ, spicula sufficiunt. Multi adeo hoc ritu cruciantur, ut tetano pereant. Quibus hoc malum non accidit, nil incommodi postea exoritur, si auro vel argento usi sunt. E reliquis verò multi gangrœnâ moriuntur.

Cum Dyaki hujus ritûs honorem non parvi faciant, parum vetat pudor, ne sese nudos ostendant. Triste est spectaculum et visu sane miserabile, istos contemplari, quos ritus hic absurdus emaciavit. Cum cupri filum inserendum est glans acu prius perforatur, et cuprum extemplo insertum carnis inflammationem excitare solet, quâ plures necantur. In Selgico regno virgo nobilis indignum haberet, maritum non hoc modo decoratum accipere."

The rites by which an eternal friendship and alliance are sworn well deserve notice, for they are at once very solemn and very savage. Both Mr. Burns and Mr. Dalton underwent the ceremony, and the latter has given a full account of it, with a naïveté worthy of an English traveller of the days of Elizabeth or James. It is as follows:—

"During my detention in Borneo, altogether nearly fifteen months, I experienced much attention and kindness from many Dyak chiefs, particularly from Selgie, with whom I was some months. Indeed, I was always of opinion that I was unsafe elsewhere. Being the first and only European he had ever seen, we no sooner met, than I informed him through an interpreter (as he could not speak a word of Malay), that I had come on the part of the Europeans to make friends with him; and trusted he and his people would do me no harm. (I mentioned this at once, fearing the Sultan of Coti (a Malay) had given some previous orders by no means favourable towards me.) Selgie replied that he was incapable of such an act, but for our future good understanding, it was proper that all his followers should know on what footing we were, and therefore requested I would make *sobat* (a corruption of the Arabic for friendship) with him; on my gladly consenting he went in person and stuck a spear into the ground above his father's grave. This being the signal for a general assembly, each of the chiefs sent a person to know the Rajah's pleasure; it was that every warrior should assemble around the grave by 12 o'clock the next day. Some thousands were present; a plat-

form of bamboo was raised about 12 feet above the grave, and on this Selgie and I mounted, accompanied by an Aji, his high priest (conjurer or doctor, in Javanese a chief). After some previous ceremony, the Aji produced a small silver cup which might hold about two wine glasses, and then with a piece of bamboo made very sharp, drew blood from the Rajah's right arm; the blood ran into the cup until it was nearly full; he then produced another cup of a similar size, and made an incision in my arm a little above the elbow, and filled it with blood. The two cups were then held up to the view of the surrounding people, who greeted them with loud cheers. The Aji now presented me with the cup of Selgie's blood, giving him the other one with mine; upon a signal, we drank off the contents amidst the deafening noise of the warriors and others. The Aji then half filled one of the cups again from Selgie's arm, and with my blood made it a bumper; this was stirred up with a piece of bamboo and given to Selgie, who drank about half; he then presented the cup to me, when I finished it. The noise was tremendous; thus the great Rajah Selgie and I became brothers. After this ceremony I was perfectly safe, and from that moment felt myself so during my stay amongst his people. Drinking the blood, however, made me ill for two days, as I could not throw it off my stomach. The Rajah took his share with great gusto, as this is considered one of the greatest ceremonies, particularly on this occasion, between the great Rajah and the first European who had been seen in his country. Great festivities followed, and abundance of heads were brought in, for nothing can be done without them. Three days and nights all ranks of people danced round these heads after being, as usual, smoked and the brains taken out, drinking a kind of toddy (tari, palm-wine), which soon intoxicates them; they are then taken care of by the women, who do not drink; at least, I never observed them."

Despotism seems well established even among the rude Dyaks, and Mr. Dalton gives a striking and curious exemplification of it. According to him,—

"The warrior can take any inferior man's wife at pleasure, and is thanked for so doing. A chief who has twenty heads in his possession, will do the same with another who may have only ten, and upwards to the Rajah's family, who can take any woman at pleasure. The more heads a man has the braver he is considered, and as the children belong to the husband, he is happy in his future prospects. On the contrary, a man of inferior note to think of the wife of a superior is entirely out of the question."

The rudeness and simplicity of the aborigines is in no case better characterised than in their superstitious dread of fire-arms. The civilised inhabitants of the Archipelago were familiar with their use when first seen by Europeans, but a period of not less than four centuries has not familiarised the Dyaks of Borneo with the effects of gunpowder, nor allayed their apprehension for it, which is greater at this moment than was that of the Mexicans and Peruvians for the arquebuses of the Spaniards under Cortez and Pizarro. Sir James Brooke, Mr. Burns, and Mr. Dalton, all bear testimony to this fact, and I transcribe the very graphic account given by the last of these authorities,—

"What these people mostly dread is the musket; it is inconceivable what a sensation of fear comes over the bravest of the Dyaks, when they have an idea that a few muskets may possibly be brought against them; no inducement will prevail on them, however numerous, to go forward; hence the Bugis (colonists from

Celebes) with a handful of men, act towards them as they think proper, making them deliver over, not only the produce of the country for a trifling exchange, but a certain number of their children yearly, whom they sell as slaves. Selgie can bring at least 12,000 fighting men, and yet the Bugis with 50 muskets and a few boat-swivels will not hesitate to meet them; the fact is, they no sooner hear the report of a gun, than they run deep into the jungle; if they are in boats they leap into the water, and after gaining the shore, never stop until they are out of hearing of the report. The most sensible of the Dyaks have a superstitious idea of fire-arms; each man, on hearing the report, fancies the ball is making directly towards himself, he therefore runs, never thinking himself safe as long as he hears the explosion of gunpowder: thus, a man hearing the report of a swivel five miles off, will still continue at full speed, with the same trepidation as at first. They have not the least conception of the range of gun-barrels. I have been frequently out with Selgie and other chiefs, shooting monkeys, birds, &c., and offended them in refusing to fire at large birds at the distance of a mile or more; they invariably put such refusal down to ill-nature on my part. Again, firing at an object, they cannot credit it is missed, although they see the bird fly away, but consider that the shot is yet pursuing and it must fall at last. The Bugis take great care to confirm them in their dread of fire-arms."

After this account of the aborigines of Borneo, we are not surprised to find one of the travellers, Mr. Dalton, declare that;—

"The Dyaks are a very peculiar race of men, totally distinct in manner and appearance from all other inhabitants of the earth;" that, "there are no people either like them or who can be said to bear them the slightest resemblance;" and that "their habits and dispositions are equally unlike those of all other nations."

All this is, indeed, true so far as concerns their manners and customs, but however these may disguise the mind and person, the race is still substantially the Malayan.

The Malays, correctly *Malayu*, are invaders and strangers in Borneo, as much as the Anglo-Saxons in Britain. Their native country, or the country to which all Malays trace their origin, is Sumatra, where they still constitute the most powerful, numerous, and civilised people. Little or nothing is known respecting the time when they settled in Borneo. In 1824, some merchants of Borneo Proper informed me that the then generation was the 29th in descent from the first settlers, the Malay "pilgrim fathers," who were not, on their arrival, converted to the Mahomedan religion. Reckoning 30 years to a generation, this would carry the date of the first Malayan settlement to the end of the 10th century of our time. I have never heard even a conjecture respecting the time in which the Malay settlements were found in other parts of the island. The whole coast, however, from Brunai, or Borneo Proper, to Kuti, usually written in our maps Coti, is occupied by Malay settlements, and, in all, *nine* principalities may be named, which, beginning from the north-western extremity of the island, and following the coast in a southerly direction, are as follow:—Brunai, Sambas, Pontianak, Matan, Mampawa, Sukadana, Banjarmasin, Pusir, and Kuti. The extreme northern

and south-eastern coasts have been considered subject to the Sulu islands, the inhabitants of which are a distinct people from the Malays, and belong to nations inhabiting the Philippine Archipelago.

Every Malayan settlement is invariably found to be on a river, a location to be expected from a people far less agricultural than maritime and piscatory. The houses of a Malay town or village are built on tall posts in the ooze, or even in the water; and on some of the rivers, as those of Borneo and Kuti, many of the best are built on floating and moveable rafts, moored to the bank, as occurs also in the Siamese capital.

All who pass at present for Malays, are evidently not of the pure stock of the original settlers, for many Dyaks converted to the Mahomedan religion and adopting the Malay language undoubtedly pass under this name. Several tribes of the aborigines are, indeed, known to have been so converted and absorbed. To such conversion the grand obstacle is well known to be the passion of the Dyaks for pork, and their unwillingness to relinquish the flesh of swine for the remote prospect of a paradise with houris in it.

A certain number of Malay words will be found in every one of the many languages of the aborigines, the proportion being always great or small in the ratio of the facility or difficulty of communication; still it cannot be said, considering the many centuries they have been settled in Borneo, that the Malays have made much progress, either in conquest or conversion. They occupy, generally, the whole coast of the island, and hold the neighbouring tribes of the aborigines in a state of helotism, leaving the whole of the interior in possession of the latter, without the power of trenching on their independence.

The Hindoo religion seems, at one time, to have made some progress in Borneo, and Mr. Dalton's statement on this subject being by far the fullest I have seen, I transcribe it:—

"That the Dyaks," says he, "are the aborigines of the country, I believe no one has hitherto doubted. Taking this for granted for a moment, for the sake of argument, how happens it that in the very inmost recesses of the mountains, as well as all over the face of the country, the remains of temples and pagodas are to be seen, similar to those found on the continent of India, bearing all the traits of Hindoo mythology? In the country of Waghoo, at least 400 miles from the coast, I have seen several of very superior workmanship, with all the emblematical figures so common in Hindoo places of worship. I cannot be mistaken, having travelled in Bengal as well as on the Coromandel coast, likewise over most parts of Java, where such remains are common; besides, I have with me fac similes of several temples discovered on the latter island and brought into notice by Sir T. S. Raffles, with prints of many of the pagodas in India. The resemblance is exact, as are the images or statues, which are found in precisely the same positions as they are to be seen in continental India, Java, and some other islands of this Archipelago. I have seen some hundred stone images of such description, and many of brass; the

latter, however, are not so common, as I have reason to believe the Dyaks melt those of that metal to fabricate fish-hooks, rings, and other articles of decoration. In most of the pagodas and temples, both within and without, are to be seen, in tolerably good preservation, hieroglyphical characters used by the Hindoos. Many of these, as well as the images, are much broken and defaced by the Ajis, or Mahomedan priests and their followers, the Arabs, who, like many sects of Christians, will tolerate no absurdities but their own."

It is to be regretted on this subject, that Mr. Dalton was not somewhat better acquainted with the details of Hindooism, and did not give us, at least, the names of a few of the many images he describes himself as having seen, with some account of the size and form of the temples. That the Hindoo religion, however, had made some progress on the western, southern, and eastern coasts of Borneo is unquestionable. On that coast is to be found some few names of places which have a Sanskrit origin. Sukadana, the name of a Malay state already mentioned, is pure Sanskrit, meaning "parrot's gift," as my friend Professor Horace Wilson informs me; and 500 and 600 miles in the interior, on the eastern side of the island, I find in the country of the Kayan names of places, in which native words are combined with Sanskrit ones, such as with kuta, a fortress; pura, a city; and karta, workmanship.* The probability is, that a better acquaintance with the country would discover others.

My opinion is, that if such remains of Hindooism exist, they were not derived directly from the country of the Hindoos, but received intermediately through the Javanese. Some of the places on the coast of Borneo have Javanese names, as Banjarmasin, which means "the salt or saline garden;" and in the languages of the aborigines a few words are to be found which are Javanese without being Malay, besides a few Sanskrit ones which probably came through the same channel.

The Chinese have been settled for several generations, chiefly on the western coast of Borneo, where they exercise a sovereignty nearly independent under a kind of commercial and republican constitution. They are chiefly emigrants from the province of Canton, and are all of the working class of society. Like their countrymen who migrate to foreign countries, the emigrants are all adult males, unaccompanied by women or children. They intermarry with the women of the Dyaks, or form matrimonial connexions with the descendants of the old settlers by native women, so that many of the colonists are at present of mixed blood. The total number of the Chinese on the western coast, including women and children, has been reckoned at 125,000, of which an unusually large proportion are able-bodied males. Their chief employment is gold digging, but a considerable number

* The name of the principality, which we write Coti, and which is more correctly written Kuti, is Sanskrit, and means in that language a little fortress.

also is engaged in agriculture. The number of immigrants which arrived yearly from China was usually 3000, but in consequence of the disturbed state of the country of late years, that number is said to have fallen off to one-third part. In fact, the Chinese of Borneo have been, with few intervals, engaged in warfare with the Dutch, in resistance to the attempts of the latter to impose taxes on them and to reduce them to a state of vassalage. Such taxes were unknown to them under the Malayan princes. The imposts complained of are a yearly capitation tax of 2 guilders a-head, a tax of equal amount for leave to settle in the country, and one of 30 guilders for leave to quit it. Since they derive no benefit whatever from the Dutch rule, but, on the contrary, much commercial obstruction, the Chinese impatience of taxation is just and natural. The great probability is, that the Chinese, if not interfered with by European powers, would in time become a powerful people, the natives giving way before them as the red men of America have given way before Europeans. Their progress, however, would be attended rather by amalgamation than by extermination, such as has happened in America in the case of the Indians, since the laws and customs of China permit only of male migration.

The Bugis are found as settlers in large numbers only on the rivers of Pasir and Kuti, lying on the strait which separates their own country from Borneo. The whole trade of these rivers is in their hands, and by their numbers, superior courage, intelligence, industry, wealth, and union, they are enabled to dictate their own terms to the Malayan princes. Throughout Borneo, there are probably about 20,000 of this nation, of all the Asiatic dwellers of the Archipelago, the best merchants next to the Chinese.

Respecting the population of Borneo, little better than conjecture can be offered. It is self-evident that the inhabitants of a country of which the major part consists of many savage hordes in a state of perpetual warfare with each other, must be inconsiderable. To expect a numerous population under such circumstances would be like expecting an abundance of game in a country where there was little food or cover for it. This is the picture which Mr. Dalton draws of the aboriginal tribes forming the bulk of the population:—

"Their tribes," says he, "are innumerable. Borneo is in every part intersected with rivers of greater or less magnitude; every river has a distinct people who will associate with no other, but wage continual war with all. The entrances of the rivers are the scenes of unceasing warfare, as they always lay in ambush about those parts, in hopes of surprising individuals who may be found fishing or straying too far from their campongs, where they may be cut off without notice or alarm. Every river has a rajah, and a large one several. In particular parts, many of these chiefs are united under one great rajah, the better to consolidate their strength and ensure protection by mutual support."

The author of a judicious memoir on the Dutch possessions on the western side of the island, which first appeared in a Singapore Journal in 1827, and was afterwards republished in Moore's 'Indian Archipelago,' in 1837, estimates their population as follows:—

Dyaks	200,000
Chinese	125,000
Malays	60,000
Bugis	5,000
Arabs and their descendants	600

This makes the whole number 390,600, but in round numbers he makes it 400,000; while he estimates the possessions in question to amount to a third part of the area of the whole island. If, then, the rest of it were equally peopled, the total population would be no more than 1,200,000. Such, however, is not the case. The western side of the island is the most populous and commercial portion of it, and, above all, contains the bulk of the Chinese settlers. Mr. Dalton estimates the area of a territory called Bagotta, on the eastern side of the island, at 1200 square miles. The intendant of the port told him that the population "might amount to 10,000," but others, whose information he considered "much better," estimated it at no more than 4000; at which rate, and calling the area of Borneo 300,000 square miles, the whole population of the island would be no more than a million.

Mr. Burns, from the information of the chiefs of the tribe, gives the population of the Kayans of the north-western coast at no more than 17,000; and after travelling over 150 miles of their territory, and judging by the amount and quality of the cultivation, he comes to the conclusion that it is very thinly inhabited, adding, that if the rest of the island be not better peopled, which he thinks it is not likely to be, the accounts given of the population of Borneo have been mightily exaggerated. Mr. Dalton and Mr. Burns seem to make the entire population of the most numerous and advanced of the aboriginal tribes, the conquering Kayans, whose extensive territories run across the island, from the China to the Java sea, only 287,000.

Judging by the scanty data before us, I do not think it would be safe to estimate the whole population of the great island of Borneo at above "one million." Let us compare this with the populousness of countries more favourably circumstanced in the same part of the world, and inhabited by the same race of men in a higher state of civilization, and occupying a more fertile territory. With an area of 40,000 square miles, Java contains 10,000,000 of inhabitants, as ascertained by an actual census. Borneo, equally well peopled, ought to contain 75,000,000.

The little volcanic island of Bali, with a mountain ridge running through it, and a peak 12,000 feet high, pouring down perennial streams of water for irrigation, and having an advanced and industrious population, although its area be no more than 2450 square miles, has a population computed at 900,000. In this proportion, Borneo ought to have had 11,000,000. The island of Luçon, the largest of the Philippine group, has an area of about 57,000 square miles, and a population of 3,500,000. Peopled like it, Borneo ought to have a population of between 18,000,000 and 19,000,000. Facts like these show, far better than any general description, and, above all, than any general assertion, the inferior capabilities of Borneo for the development of civilisation. All the other islands named have invented arts and letters, and have a population considerably civilized and humanized. Borneo has made small progress in the arts, and invented no letters, while its native inhabitants are savages, practising head-hunting and other barbarous rites, and now and then indulging in a human sacrifice. Since the race is one and the same in it and the other islands, it seems difficult to account for the backwardness of man in this great country, except by attributing it to the inferiority of its physical geography. The Malayan race, although settled in Borneo for many centuries, has itself made little advancement; and the climate is but too palpably unsuited to Europeans, who, although connected with it for several ages, have, instead of working any good for it, done it infinite mischief by sheer worthless meddling. But it is the reverse with the Chinese, who are not only suited by constitution to live in the climate of the Equator, but by intelligence and industry to thrive in it. Had they, in fact, been from their first settlement as unobstructed in their colonization there as the Anglo-Saxon race in North America, I cannot doubt but that a great Chinese empire would by this time have been in existence in Borneo, and Europe and America reaping great advantages from a commercial intercourse with it.

It is proper that in concluding this essay, I should state to the Society that it is a mere compilation, and not derived from personal information of the island itself, for all that I have seen of it is confined to my having landed on it for a few hours when I accompanied the expedition which, in 1811, effected the conquest of Java.

III.—*Observations on the Stature, Bodily Weight, Magnitude of Chest, and Physical Strength of the New Zealand Race of Men.* By Dr. Arthur Saunders Thomson, 58th Regt.

Communicated by the Colonial-Office.

Read May 10, 1852.

"The stature of the men of New Zealand," observes Captain Cook, "in general is equal to the largest of those in Europe; they are stout, well limbed, and fleshy." Almost every succeeding writer since then has described the New Zealanders as a tall, strong, and well-proportioned race. But as such statements convey to the mind no definite information and furnish no data by which a comparison can be made with other races of men, I have thought some interesting, if not useful, information might be derived from a statistical inquiry into the above subjects.

1*st. On the Stature.*—During the month of April, 1849, many natives of New Zealand presented themselves at the military hospital for vaccination, and on that occasion I took down, indiscriminately, the height of 147 men, and the results were as follows:—

		Ft.	in.		Ft.	in.	
6	men were	5	0	to	5	1	in height.
1	man was	5	2	to	5	3	,,
2	men were	5	3	to	5	4	,,
9	,,	5	4	to	5	5	,,
20	,,	5	5	to	5	6	,,
37	,,	5	6	to	5	7	,,
20	,,	5	7	to	5	8	,,
18	,,	5	8	to	5	9	,,
17	,,	5	9	to	5	10	,,
13	,,	5	10	to	5	11	,,
2	,,	5	11	to	5	12	,,
1	,,	5	12	to	5	13	,,
1	,,	6	$5\frac{1}{2}$		—		,,

The mean height of these 147 New Zealanders was 5 feet 6 inches and nearly $\frac{3}{4}$ of an inch.

For the sake of comparison, I examined 617 men of the 58th regiment, and found their average height was 5 feet $7\frac{3}{10}$ inches; but as soldiers are a selected body, and many men are rejected in consequence of low stature, it is obvious this is not a fair comparison. I have, therefore, to obviate this objection, drawn up the following statement:—

Table showing out of 100 New Zealanders and 100 natives of Great Britain and Ireland* the proportion of men among each race above 5 feet 6 inches in height:—

Stature.	Out of 100 New Zealanders there were	Out of 100 Natives of Great Britain there were
From 5 ft. 6 in. to 5 ft. 7 in. . .	35	25
5 7 ,, 5 8 . .	18	24
5 8 ,, 5 9 . .	17	22
5 9 ,, 5 10 . .	15	14
5 10 ,, 5 11 . .	12	9
5 11 and upwards . .	3	6
Total	100	100

It will be seen from the above that there is no very great difference in the stature of the two races.

The Table is thus read:—Out of 100 natives of New Zealand, 35 are from 5 feet 6 inches to 5 feet 7 inches in height; whereas among the natives of Great Britain there are only 24 between this standard; and it will be seen that the number of men from 5 feet 9 inches to 5 feet 10 inches, among each race, is similar; but among the English there are twice as many men 5 feet 11 inches and upwards as there are among the New Zealanders.

It is not, however, in my power in this country to make a fair comparison on this question; but I have furnished materials which will enable others to do so. I may, however, observe that Haller reckons the mean height of the men in the temperate countries of Europe to be 5 feet 5 inches and 5 feet 6 inches.

The New Zealanders, like the English, do not reach their full stature until they are upwards of 20 years of age: and the mean height of 46 men, from 16 to 20, was 5 feet 6 inches; whereas, from 21 to 25, it was 5 feet $6\frac{3}{4}$ inches.

The natives of New Zealand have no idea of years with reference to their age, so that when I speak of their age it is to be clearly understood that it is an age given to them by myself from their general appearance.

On the Bodily Weight.—A man may have a certain stature,

* The Natives of Great Britain and Ireland, from which the data of this Table are drawn, were soldiers of the 58th Regiment. Among the men observed, the Grenadier and Light Companies were included (generally the largest men in the Regiment), and out of 617 men there were

27	men	5 ft.	5 in.	to	5 ft.	6	inches in height.
149	,,	5	6	,,	5	7	,,
140	,,	5	7	,,	5	8	,,
129	,,	5	8	,,	5	9	,,
84	,,	5	9	,,	5	10	,,
54	,,	5	10	,,	5	11	,,
34	,,	5	11	,,	6	3	,,

but unless he has weight of body he will not be able to undergo much labour. With the view of ascertaining the bodily weight of the New Zealanders, I carefully weighed, in a common lever balance, 150 men, and found—

8	men were	8	stone in weight,	but under	9	stone.
25	,,	9	,,	,,	10	,,
54	,,	10	,,	,,	11	,,
41	,,	11	,,	,,	12	,,
19	,,	12	,,	,,	13	,,
3	,,	13	,,	,,	14	,,

The average weight of these 150 New Zealanders, deducting their mats and clothes, was 10 stone 1 lb., avoirdupois.* With the same balance and weights I examined 617 men of the 58th regiment, and found their average weight was 10 stone 3 lbs.

It therefore appears that, so far as weight of body is concerned, there is little or no difference between the two races.

To render this difference more obvious, and to point out what weight is most common, I have drawn up the following statement.

TABLE showing out of 100 natives of New Zealand and 100 natives of Great Britain † the proportion of men found of different weights :—

Weights.	Out of 100 New Zealanders there were	Out of 100 Natives of Great Britain there were
8 stone but under 9	5	2
9 ,, 10	17	19
10 ,, 11	36	36
11 ,, 12	27	33
12 ,, 13	13	8
13 stone and upwards	2	2
Total	100	100

This Table shows how remarkably similar the two races are in weight.

With the view of showing what influence age has on weight I have drawn up the following statement.

* The New Zealanders from whom these observations were drawn were generally either Waikato natives or men employed upon public works. Both classes are better fed than the natives generally of New Zealand; the Waikato from their trade in pigs, and the men on the works from the pay they receive for their labour.

† Out of 622 Soldiers of the 58th Regiment

2	men were	7	stone	but under	8
15	,,	8		,,	9
115	,,	9		,,	10
224	,,	10		,,	11
206	,,	11		,,	12
46	,,	12		,,	13
7	,,	13		,,	14
1	,,	14		,,	15
6	,,	15			

Table showing the average weight of New Zealanders and natives of Great Britain at different periods of life:—

Ages.	New Zealanders.			English, Scotch, and Irish.		
	Number observed.	Average Weight.		Number observed.	Average Weight.	
		Stone.	lbs.		Stone.	lbs.
From 16 to 20 years, inclusive .	46	9	7	47	9	11
21 to 25 ,, .	40	10	5	274	10	4
26 to 30 ,, .	47	10	$5\frac{1}{4}$	213	10	$4\frac{1}{2}$
30 and upwards	11	10	10	83	10	2
Total	144	10	1	617	10	3

Under 21 years of age the New Zealanders are less developed than the soldiers; but after 21 years of age the bodily weight of the New Zealanders is always a little above the soldiers of the 58th regiment.

I may here observe that the falling away in bodily weight, which the foregoing Table shows, after 30 years of age is, I am induced to think, peculiar to soldiers; for it has been remarked there is something in the life of a private soldier more deteriorating to the constitution than the life of a day-labourer.

Among Europeans in civil life the weight of the body, like that of the New Zealander, will probably be found to increase up to 45 years of age.

The New Zealanders, as all men in a savage state, are indolent and lazy, working only when there is an absolute necessity for so doing. A few days' labour will enable them to plant sufficient food to sustain them for a year; and a great portion of their time afterwards is often spent in a dreamy state of idleness—a life which tends to develope the accumulation of fat, and to increase the weight of the body. As the New Zealanders advance in life the amount of labour they perform generally diminishes.

Among many races of men there is some particular part of the body where a great development of muscle or fat is found, which peculiarity adds to the size and weight of the body. This development is found in the lower extremities of the New Zealanders; for, with few exceptions, their thighs and legs are much larger than those of Europeans.

On the Magnitude of the Chest.—There is a popular opinion that people who have large chests are able to undergo much labour and endure great fatigue. I have therefore examined the mean girth of the chest* of 151 New Zealanders, and found the following results:—

* The examination is made by passing a measuring tape round the chest on a level with the mammillæ, the arms being raised above the head so as to remove as much of the muscular substance as possible; during the time of measurement the

1	man's	chest measured	29	inches,	and under	30	inches.
2	,,	,,	30	,,	,,	31	,,
3	,,	,,	31	,,	,,	32	,,
14	,,	,,	32	,,	,,	33	,,
9	,,	,,	33	,,	,,	34	,,
25	,,	,,	34	,,	,,	35	,,
33	,,	,,	35	,,	,,	36	,,
28	,,	,,	36	,,	,,	37	,,
23	,,	,,	37	,,	,,	38	,,
9	,,	,,	38	,,	,,	39	,,
3	,,	,,	39	,,	,,	40	,,
1	,,	,,	40½				

The mean circumference of the chest of these 151 New Zealanders was 35·36 inches.

To prevent any mistake, with the same measure that I took the magnitude of the New Zealanders' chests I carefully examined 628 men of the 58th regiment,* and found their mean girth of chest was 35·71 inches.

It therefore appears there is very little difference in the magnitude of the chest of the two races of men. The small amount of difference disappears when the comparison is made in the following manner.

TABLE showing the average circumference of the chest of the Natives of New Zealand and the Natives of Great Britain at different periods of life:—

Ages.	New Zealanders.		Natives of Great Britain.	
	Number observed.	Average Number of Inches round the Chest.	Number observed.	Average Number of Inches round the Chest.
		Inches.		Inches.
From 16 to 20 years . .	46	33·32	47	34·90
21 to 25 ,, . .	40	35·82	274	35·55
26 to 30 ,, . .	47	35·92	213	35·91
Above 30	11	35·95	83	35·76
Total	144	35·26	617	35·71

person was engaged in conversation, so as to prevent the chest being unusually distended with air.

* Of the 628 men of the 58th Regiment examined

1	man's chest measured	29	inches	but under	30	
1	,,	30		,,	31	
6	,,	31		,,	32	
27	,,	32		,,	33	
49	,,	33		,,	34	
97	,,	34		,,	35	
145	,,	35		,,	36	
133	,,	36		,,	37	
85	,,	37		,,	38	
56	,,	38		,,	39	
19	,,	39		,,	40	
7	,,	40		,,	41	
0	,,	41		,,	42	
1	,,	42		,,	43	
1	,,	43.				

It will be seen that, from 16 to 20 years of age, the New Zealanders' chests are more than ½ an inch smaller than those of the soldiers; after this age the similarity in the two races is very great. At first sight it might be expected, as the English are a taller race, their chests should be larger; but it has been found, by the measurement of 1400 recruits by Staff-Surgeon Balfour, that stature has not a very great effect on the girth of the chest.

On the Physical Strength.—Having had weights arranged so that they might be raised from the ground with both hands, I collected 31 New Zealanders, and found they raised the following number of pounds, avoirdupois:—

			lbs.		lbs.
6	New Zealanders	raised	410	to	420
2	,,	,,	400	to	410
5	,,	,,	390	to	400
3	,,	,,	380	to	390
6	,,	,,	360	to	380
5	,,	,,	340	to	360
2	,,	,,	336		
2	,,	,,	250	to	266

The mean weight raised by these men was 367 lbs.; the greatest, 420; the smallest, 250.

I then got 31 soldiers, taken indiscriminately, whose average weight was 10 stone 4 lbs., without their clothing, and found they raised from the ground, with the same arrangement of weights, as follows:—

		lbs.		lbs.
2	men raised	504		
8	,,	460	to	480
14	,,	400	to	460
9	,,	350	to	400

The average weight raised by these 31 soldiers was 422 lbs., or 55 lbs. more than the men of New Zealand.

It is therefore obvious that, in physical strength, the English are far superior to the New Zealanders.

The New Zealanders taken for this trial were chiefly on the Government works, men accustomed to lift weights, and better fed than many of their countrymen.

Perron, in his 'Voyages des Découvertes aux Terres Australes,' states that the weakest Frenchman was equal in the hands to the strongest man of Van Diemen's Land; and the weakest Englishman stronger than the strongest New Hollander. If such be the case, the natives of New Zealand, although inferior to the English, are much superior to the natives of New Holland.

Concluding Remarks.—From the foregoing facts the following results are deduced.

1st. That the men of New Zealand are about ¼ of an inch lower in stature than the soldiers of the 58th regiment; and that

there are comparatively few men among them above 5 feet 11 inches.

2nd. That the average height of the New Zealanders is ½ an inch higher than the mean height Haller states the men of the temperate countries of Europe to be.

3rd. That the New Zealanders do not reach their full stature until they advance over 20 years of age.

4th. That the bodily weight of the natives of New Zealand and of the men of the 58th regiment is very similar.

5th. That after 30 years of age the New Zealanders increase in weight; but that after this soldiers lose flesh.

6th. That about 20 years of age the English are more developed than the New Zealanders.

7th. That the mean girth of the chest of both races is very similar.

8th. That the New Zealanders are in physical strength inferior to the inhabitants of Great Britain.

The great difference between the two races *in physical strength* is what would not be expected from their similarity in stature, weight of body, and magnitude of chest. This result I am inclined to attribute solely to a large proportion of the New Zealander's food being composed of vegetable matter—a diet which, it is said, tends to develope the accumulation of fat in the system, without adding much, if at all, to the substance of the muscles.

To those who delight in thinking that the world is degenerating, and that men were stronger in olden time, before trade and civilization had changed the manners and customs of men, the foregoing facts may prove interesting; for here we observe the New Zealanders, a race just emerging from the darkest savage state, and we find that in physical strength they are much inferior to men drawn from a country where machinery and civilization have produced changes in the manners and habits of the people to an extent unknown among other civilized races.

IV.—*Survey of the Sea of Aral.* By Commander Alexey Butakoff, of the Imperial Russian Navy.

Communicated in a letter to Sir Roderick I. Murchison.

Read December 13, 1852.

Sir,—I have the honour to submit to your indulgent consideration the subjoined short notice on the Sea of Aral, explanatory of the chart, which I hope you have already received. However incomplete, I flatter myself with the idea that it will not be with-

out some interest, as no one has had the opportunity of navigating in those waters before my companions and myself.

In presenting this notice to yourself and the illustrious Society over which you preside, I beg leave to add, as an apology for its defects, that it is not written by a man of science, but by a rough sailor, and in a language which is not his own.

With the sincerest respect,
I have the honour to be, &c.

Orenburg, 19*th* (31*st*) *Aug.* 1852. ALEXEY BUTAKOFF.

Before the year 1848, the Sea of Aral was laid down on maps only from superficial and partial information derived from the native Kirghiz. In 1846 the astronomer M. Lemm was charged to determine a series of astronomical points in the Steppe, from the fortress Orskaïa to the banks of the Syr Dariá (Jaxartes). In 1847, a small vessel, the schooner 'Nicolas,' built at Orenburg, after the model of Caspian fishing-vessels, and destined for the survey of the Sea of Aral, was transported in pieces over the Steppe to the Syr Dariá. After being put together and launched, she had only time that season to make the survey of a part of the eastern coast, 70 versts southward of the mouths of the Syr Dariá. During the first part of the summer of 1848, MM. Akisheff and Goloff, belonging to the Corps of Topographers, made on board the 'Nicolas' the trignometrical survey of the whole northern coast, from the mouths of the Syr to the Cape Kum Suat.

In the beginning of 1848 I had the honour of being appointed at the head of a hydrographical expedition, charged with the complete exploration of the Sea of Aral. Arrived at Orenburg the 5th (17th) March, I began immediately the construction of the flat-bottomed schooner 'Constantine,' 50 feet long, which being finished on the 28th April (10th May) was transported in pieces over the Steppe, put together at Aralsk (Raïm), launched the 20th July (1st August) into the Syr, and on the 25th July (6th August) I sailed in her to explore the Sea of Aral.

The results of my first exploring voyage were—1st, a general reconnoissance of the sea; 2nd, soundings in divers directions; 3rd, the determination of many latitudes; 4th, a geodesical survey of the Isle Barsa-Kilmess; and, 5th, the discovery and survey of a group of islands, which I named *Islands of the Czar*, and which were entirely unknown even to the Kirghiz. The largest of these islands, *Nicolas the First*, is covered with steppe-wood (saksaul, anabasis ammodendron, or pinus orientalis, janquil, &c.), and its only inhabitants were innumerable saigaks, a sort of antelope. There were no vestiges of human beings, and the best proof that none have ever been there, was the circumstance that the saigaks,

generally very timid and watchful, did not fly from us, out, on the contrary, looked at us with a sort of curiosity. Such confidence could not last long; and, after two months' difficult navigation, living on salt food, exposed to constant heat and hard labour, we were but too happy to feed on the dainty flesh of these innocent animals.

I passed the winter of 1848-9 on the Isle Koss-Aral, at the mouth of the Syr, in a small fort, protecting our fishery, belonging to a company of Orenburg.

The only remarkable incident of my wintering there was a tiger-hunt in our near neighbourhood. On my return to the Syr, the first news was that a tiger had recently devoured four cows belonging to the fishery, on one of the islets of the delta. About two weeks afterwards I heard from the Kirghiz, that the same animal had devoured two men and a number of sheep; and on the 21st Nov. (3rd Dec.) the foreman of the fishery reported to me that this tiger had killed their horse at only 3 versts from our fort. It was necessary therefore to exterminate such a neighbour at any rate, the more that his fresh traces were seen quite close to us on the sand; and I went immediately against him with 35 men of my garrison. We made a battue and it was lucky; the tiger being killed without any injury to us. It was a real royal tiger, of a beautiful orange colour with broad black stripes, uncommonly fat, and 6 feet 4 inches long from the nose to the beginning of the tail. Tigers roam constantly in the vicinity of Aralsk, and particularly in winter, notwithstanding the frosts. On surveying the eastern coast of the sea I found in many places perfectly fresh traces of tigers' paws on the sand of the strand. Almost every year our soldiers and Cossacks kill two, three, even four of those animals.

I began my next campaign the 5th (17th May). Having charged M. Pospeloff, who received the command of the 'Nicolas,' with the survey of the eastern coast, its islands, and the sounding of the northern part; I took the rest of the coasts to myself, as well as the determination of the astronomical points, and the sounding of the open sea. Thanks to Providence, and the most exemplary zeal of all my subordinates, our labours were crowned with the most complete success; notwithstanding manifold risks and difficulties, inseparable from an exploring expedition on waters so boisterous and so completely unknown. Notwithstanding a good deal of privation, we returned from our work with entire and healthy crews; though the vessels had become leaky. Generally speaking for such expeditions, nobody can be better suited than a Russian sailor or soldier—for he is active, intelligent, obedient, patient, and adventurous; it is not easy to discourage him—he laughs at privations, and dangers have in his e es a particular sort of charm.

I consider it an agreeable duty to render the most complete justice to the zeal and ability of M. Pospeloff, who executed, in the most creditable and conscientious manner, the survey of the eastern coast; to our topographers, Rybin and Khristoforoff; to the Assistant-Surgeon, Istomin, who, beside his medical duties, was my assistant-astronomer; and to the non-commissioned-officer, Werner, who acted as mate, geologist, and botanist.

Of the astronomical results I think it necessary to say a few words of explanation. The latitudes are determined by meridional altitudes of the sun. Wishing to have for my longitudes an independent starting-point, I determined that of Koss-Aral (the fort) by lunar distances from the sun, and attached to it all the other points chronometrically. The longitudes of M. Lemm are calculated from the first geographical meridian, and as I wanted to attach mine to two of his, I took the difference of longitude between Greenwich and Ferro 17° 45′ 8″, communicated to me by the late Admiral Bellingshausen, under the idea that the first geographical meridian passes still through that island. On placing those two points (Aralsk or Raïm and Ak-Djulpass) on my chart I found them exactly corresponding with the geodesical survey of that place, and was satisfied with that circumstance. But on my return to St. Petersburg I learned—a thing not much known among sailors—that geographers take their first meridian 20° W. of Paris, without reference to the Isle of Ferro. This makes a difference of about 0° 5′ between my longitudes and those of M. Lemm. Which of us is right and which wrong? My longitude of Koss-Aral was the result of two lunar distances from the sun, one eastern and the other western. Every one acquainted with astronomy knows to what errors the mode of taking lunar distances is liable even with experienced astronomers. On the other hand, the longitudes of M. Lemm were determined chronometrically from the fortress Orskaïa—consequently, even with his well-known skill, some slight variations in the rate of his chronometers might have occurred in a long lapse of time. I hope to settle that point by determining the longitude of Aralsk by means of occultations of the stars, by the moon, and by meridian passages of the moon. For this purpose our distinguished astronomers, MM. Simonoff, Savitch, and Knorre have promised me their kind co-operation. After that I shall take as accurately as possible the chronometrical difference between Aralsk and the fort of Koss-Aral—(an ophthalmia did not allow me to do it at the end of my exploring campaign)—and thus I shall correct all the longitudes of the Sea of Aral. I hope that this will also serve to correct the longitudes of M. Lemm.

The northern and eastern coasts of the Sea of Aral, and the

Islands of the Czar, Kug-Aral, Barsa-Kilmess, Bellingshausen, are surveyed geodesically "*à la planchette.*" The capes Kum-Suat and Isendé-Aral are placed after their latitudes and bearings by compass (corrected by its declination) from Uzun-Kaïr; the cape Tubé-Karà and the southern extremity of Barsa-Kilmess are placed after their latitudes and bearings from Isendé-Aral. I had before the survey of the western coast, also "*à la planchette,*" but finding it too dangerous because of the violent winds and breakers, I was obliged to content myself with the common maritime survey, by bearings from the vessel.

The southern coast and Isle Takmak-Aty are surveyed in the same manner. On comparing the survey of the western coast with the astronomical points, Ak-Tumsuk and Ak-Suat, I found them almost coinciding the one with the other.

Not being a geologist or naturalist, but wishing to make my labours useful to science, I begged Colonel Helmersen, Inspector of the Imperial School of Mines, to furnish me with advice. I am particularly obliged to him for the clearness and precision of his instructions, by the aid of which one of my subordinates, the non-commissioned officer Werner, collected samples of rocks, measured the thickness of the strata, and noted their inclination and direction: he also collected samples of plants, with roots and flowers, according to instructions which the late Admiral Bellingshausen had the kindness to send me. The geological collection was despatched to the Institute of Mines, and Colonel Helmersen wrote a description of it in German, which he sent to the Baron von Humboldt; whilst 75 samples of the Aralese Flora were sent to M. Fischer, formerly director of the Imperial Botanical Garden. The zoology and ornithology of these places must be known from the descriptions of MM. Lehman and Basiner. On the desert coasts and islets there are immense quantities of pelicans, cormorants, sea-gulls, and sea-swallows: the birds of passage are swans, geese, both red and common, and ducks. A great many wild hogs live in the reeds of the eastern coast; and on the sand of the margin, as I said already, we saw frequently tiger-traces.

The coasts of the Sea of Aral present a perfectly dead and barren desert. The northern coast is composed of argillaceous table-land, from 200 to 300 feet high, abrupt to the S., and sloping to the northward; the isles Kug-Aral and Barsa-Kilmess are of the same character. Near Tchubar-Tarauz fresh water is to be found in wells, in sands. The sands Little Borsuki finish hereabouts. The eastern coast is sandy, with hills of sand mixed with clay, of about 80 feet high. All this coast is covered with steppe-wood, or rather brushwood, as well as most of the adjacent sandy islands—saksaul, or anabasis ammodendron, djanquil, kooyan-sooyuk, &c. The margins of the

coast and islands are covered with reeds. The eastern coast, southward of the mouths of the Kuvan-Dariá, now dry, is intersected by creeks, deeply cutting into the land, with shallow entrances. Along it I found many strongly saline lakes. In the wells which we dug in many places along the whole eastern coast, we found only very bitter, salt water, and for that reason caravans do not pass that way. Kush-Djitmess, Tchutchka-Bass, and Menschikoff, were the only islands where we found fresh water in wells. The western coast is composed of the table-land Ustyurt, from 200 to 300 feet high; it begins at Kara-Tamak (Black Throat), to which the sands Great Borsuki also reach. The Ustyurt is abrupt to the sea-side, and composed of strata of argillaceous schist (flagstone), sandstone, and limestone. Small and scarce tufts of bright-green grass and reeds are seen in some places on the abrupt side of the Ustyurt, and indicate the presence of fresh water. Along the Ustyurt Kirghiz caravans pass, and I have seen one of about 500 camels; but these animals are reduced to drink salt water. The southern coast is entirely flat, and composed of alluvions of the Amu-Dariá (Oxus). Here wander the nomad tribes called Karakalpaks, subjects of the khan of Khiva.

The water of the Sea of Aral is salt, but in a less degree than that of the ocean: its taste resembles that of the Gulf of Finland, at about 100 versts from Cronstadt. I suppose that the reason of this brackish condition is the enormous quantity of fresh water poured into the sea by the two large rivers, Syr and Amu Dariá (Oxus).

At one time, with three anchors out in breakers, close to a lee shore, with our provision of fresh water exhausted, we were obliged to use salt water during about two weeks, and the consequence was a strong diarrhœa, from which we all suffered severely. I lost a bottle of this sea-water in the strong frost, on my return to Petersburg.

The Sea of Aral, in Kirghiz Aral-Tenghiz (Sea of Islands), is divided by the Kirghiz into two unequal parts: the *Little Sea*, which comprises the northern part to the southern extremity of the Isle Barsa-Kilmess, and which freezes almost every year, and over the ice the natives pass with their cattle, horses, and camels; and the *Great Sea*, which includes all the rest, and which freezes only along the coasts. Some of the oldest of the Kirghiz told me, that they had heard from their fathers, that once, during an uncommonly hard winter, all the sea was frozen. Probably, therefore, the saigaks came over the ice from the continent to the Island Nicolas the First. The level of the Sea of Aral, it seems, is constantly sinking:* which is particularly visible on some cliffs

* This may be due to elevation of the land, like that of the coast of Norway and some shores of the Mediterranean.—*R. I. M.*

of the Ustyurt and the Isle Nicolas, where there are evidences of the action of water on heights to which the waves of our days cannot attain in the most violent storms. The bottom of the Sea of Aral, as seen by the soundings on the chart, presents a depression to the N.W. coast, where the greatest depth, we found, was 37 fathoms. The ground is mud in the centre of the sea and along the northern and western coasts; about the eastern and southern it is sand, or sand with shells. Rocky reefs are only to the southward of the peninsula Kulandỳ and the Isles Nicolas and Constantine; the rest of the bottom is clear.

The mouths of both large rivers, which fall into the sea, are very much obliterated by sands and mud; the deepest channel of the Syr has seldom 4 feet, but generally 3½, 3, and sometimes only 2½ feet in spring and summer. The water in the river is highest in June and July, caused by the melting snows on the summits of its mountains; but towards autumn the water of the Syr falls considerably, and near Aralsk, at 70 versts from the mouth, the difference of high and low water levels is about 3½ feet. During the winter the ice lies on the ground in many places of the delta, and the current, washing its way below, deepens the channels; but towards the autumn the great quantity of mud and sand, forced on by the stream, obliterates them. A considerable quantity of water from the Syr goes into lakes and bogs, which the river fills about its mouth, and which are thickly overgrown with reeds, as well as both banks of the Syr; the reeds are there in many places about 20 feet high. The principal fishes of the Syr and Aral are the sharp-nosed sturgeon and the Silurus, or bony pike. Other large and valuable fishes, which abound in the Ural river and Caspian sea, are not to be found here, nor are there any seals or crabs. The smaller species of fish are, however, almost the same as those of the Caspian.

The Syr-Dariá falls into the Sea of Aral by two branches, to the N. and S. of the Isle Koss-Aral; the southern has a very feeble current, is grown up with reeds and rushes, and at the mouth, which is very much obliterated by sands, washed on by the sea-waves, and by the alluvions of the river itself, is very shallow. In the northern branch are many small islets, and the depths are there as I said above. In former times the Kuvan-Dariá fell into the Sea of Aral, also a branch of the Syr; but now it has very little water; and the Kirghiz, anxious not to lose that which accumulates at the melting of snows and serves them for their cattle and irrigation, have barred the mouth at a distance of about 50 versts from the sea. At present the Kuvan pours not a drop of water into the sea; in summer and autumn the water remains there only in small lakes, the communication between which is dried

up. The oldest inhabitant *aksakal* (white beard) of my Koss-Aral neighbours told me that in olden times, about 60 years back, the Kuvan had more water than the Syr, and the stream was so strong that it "turned stones" At that time the southern branch of the Syr was the principal one, for the quantity of its water and strength of current. The same old man told me that the Yanghee-Dariá (another and more southern branch of the Syr, now entirely dried up), of which we saw no traces, had water at that time and a very feeble current. Generally speaking, as much as could be observed, and conforming to this information, the Syr changes its bed to the northward. Its banks are very low from Aralsk to the mouths, and the islets of the delta heighten constantly from the annually accumulating sediment at high-water. About Aralsk, and at some distance up and down the river, its overflowings are contained by mud-dams, made formerly by the Karakalpaks and maintained by the Kirghiz. At the period, therefore, of high water, the level of the river is higher than that of the fields and kitchen-gardens along the banks, which are easily irrigated.

Of the climate of those countries I shall only say, that the summers are exceedingly hot and the winters very cold for such low latitudes. As there is a meteorological observatory of four years' standing at the fort Aralsk, M. Kupffer, the distinguished member of the Imperial Academy of Sciences, has certainly a much fuller and better store of climatological information than I can give, and the more so as my barometers were spoiled during the voyage over the Steppe. In the winter of 1848-49, which I passed at Koss-Aral, the frosts began the 22nd October (3rd November), and the small lakes filled by the Syr were so well frozen that I skated on them. The Syr-Dariá was covered with ice the 26th November (8th December), and broke up the 3rd (15th) April. During the winter, heavy loaded sledges, drawn by three horses, crossed over the ice, and the frosts reached frequently $-18°$ R. Snow-drifts were frequent and often very violent. In summer the heat on shore is intolerable, and rain is a most unwonted curiosity. The air is purified only by the domineering winds, which blowing almost constantly between W.N.W. and E.N.E., sweep away miasma and unwholesome evaporations rising from fresh-water bogs and reeds, and which are so unhealthy in other countries. These winds render the navigation on the Aral Sea very difficult. They often blew in gales, and put us in our small vessels into imminent danger, forcing us to incur risks which could be justified only by the proverb, "All's well that ends well." The winds, freshening almost suddenly, raise a very boisterous sea, and then, falling again suddenly, leave behind them a most intolerable swell. Generally speaking, the

Sea of Aral is very stormy and turbulent, but the climate of its shores, however little agreeable, is not unhealthy.

Finally, I adjoin the astronomical points which I determined, adding to them the latitudes and longitudes of Aralsk (Raïm) and Ak-Djulpass, determined by M. Lemm, as before mentioned. I thought it useless to enumerate those points of which I had only latitudes without longitudes.

Astronomical Points.	Latitudes N.			Longitudes E. from Greenwich.		
	°	′	″	°	′	″
The fort Koss-Aral (by distances ☉ ☽)	46	1	17·7	61	1	44·6
Aralsk or Raïm } by M. Lemm	46	4	19	61	41	48
Ak-Djulpass } by M. Lemm	46	41	32	61	43	43
The southern coast of the entrance into Tchubar-Tarauz	46	44	42·2	60	30	59·6
Cape Uzun-Kaïr (S. point of Kulandy̆)	45	46	3.5	59	17	44·9
Cape Ak-Tumsuk (on the Ustyurt)	44	36	1·8	58	18	47·7
Cape Ak-Suat (S. W. corner of the sea)	43	42	41·2	58	22	6·5
Isle Nicholas I. (southern bay)	44	59	4·6	59	16	54·6
Isle Bellingshausen	44	35	35	58	56	11
Isle Yermoloff (mouth of Djan-Dariă)	43	43	23·3	60	18	30·6
Cape Kungăn-Sandau (eastern extremity of the sea)	44	52	43	61	46	44·8

V.—*Notes on the Possessions of the Imaun of Muskat, on the Climate and Productions of Zanzibar, and on the prospects of African Discovery from Mombas.* By Colonel SYKES, F.R.S., F.R.G.S.

Read June 14, 1852.

LIEUTENANT FERGUSSON, of the Indian Navy, at present in charge of the magnetic and meteorological observatory at Bombay, lately transmitted to me a record, during eleven months in 1850, of the indications of several meteorological instruments kept at Zanzibar. As far as I am informed, nothing of the kind has ever been before attempted, the understood extreme insalubrity of the climate for European constitutions having deterred any competent and willing person from a residence at Zanzibar for any length of time sufficient to render meteorological observations of any scientific or normal value. In the present instance, the apothecary (I believe an Eurasian, or half caste) who made the observations was compelled in the twelfth month of his residence to abandon his post, his medical duties, and his meteorology to save his life. A glance of the eye over the observations satisfied me that the atmospheric phenomena were not of a usual character for the

latitude; but before discussing them in detail, I sought in geographical works for information which might enable me to refer to local physical circumstances the cause or causes of the unusual meteorological phenomena: but I looked in vain; for, to my surprise, the information regarding Zanzibar and the N.E. coast of Africa, with the exception of the soundings along the E. coast of Central Africa, scarcely exceeds meagre phrases destitute of precision. This is the more remarkable, considering that the E. coast of Africa—at least from the Red Sea to the equator—has been known to Europeans from the earliest times. It is mentioned in the Periplus of the Erythræan Sea; in Pliny; Vasco de Gama visited the coast in his voyage to India; the Portuguese held possessions and forts for at least half a century; the French formerly visited Zanzibar and the coast of the main for slaves from Bourbon and the Mauritius; and the English and Americans continue to trade with Zanzibar. Opportunities have not been wanting, therefore, for obtaining facts upon all points, instead of "hearsays" upon most points. All that Reece's Cyclopædia communicates is—

"That Zanzibar is an island of Africa, on the coast of Zanguebar, governed by a king who is tributary to the Portuguese."

The modern Penny Cyclopædia, quoting Capt. Owen's 'Voyage to survey the Eastern Coast of Africa,' is a little more instructive—at least as far as the region of Zanguebar is concerned; but there are very indefinite expressions about Zanzibar; for instance, it is said to be twice the size of the island of Pemba, which is represented to be 30 miles long and 10 wide; while the length and breadth of Zanzibar, from Capt. Owen's chart, is 48 geographical miles long and 18¼ broad in the widest part. Zanzibar is *said* also to produce every kind of grain grown in the tropics, besides great quantities of sugar, which is exported to Arabia, the Red Sea, and even to Egypt, but upon what authority does not appear. The channel between Zanzibar and the main is studded with islands, and is about 15 miles wide. One branch of manufacture is carried to a considerable extent, that of round shields 18 inches in diameter, made from the hide of the rhinoceros, which, after being soaked or boiled, can be moulded into any form; but in the general account the phraseology is frequently so indefinite that little weight can attach to the descriptions; for instance, Monteca "is little known;" it *seems* to be somewhat smaller than Pemba; it rises abruptly from an unfathomable depth, and is based upon a coral formation; the surface is covered with trees, and it *appears* to be tolerably well peopled. A little farther on, speaking of the region of Zanguebar, the account says, "the productions are various, but *very little known*;" yet various grains and fruits are mentioned, the sea abounding with fish, the rivers with

hippopotami, and the forests with elephants, rhinoceri, lions, and leopards; that the year is divided between the dry (which is not the fact, however) and rainy seasons: the rainy season generally commencing, *it is said*, four or six weeks after the sun has passed the zenith. Now the sun passes the zenith of Zanzibar in going south about the 9th of October, and again in going north about the 4th of March; and though there is rain in every month of the year, according to the meteorological record, yet the great falls are in the months of March, April, May, October, and November. The two monsoons, therefore, if they may be so called, would appear to be coincident with the two passages of the sun over the zenith of Zanzibar; the fall increasing, certainly, with the increasing declination of the sun for 10 or 12 degrees; but the year is plainly not divided into the dry and wet seasons. Again the heat is *said* to be very great in summer, but it is not really so, as the maximum is only 88° Fahr., and the mean temperature of the hottest month (February) is only 83°.4; while on the continent of India the heat in many places frequently exceeds 100° Fahr.; and at Bagdad, on the Tigris, in the second story of a house on the river, on the 19th of July, 1848, at 2 P.M., the thermometer stood at 122°.9, and the *lowest* heat in the month, at 2 P.M., was 101°.3; and Colonel Rawlinson has told me that he has known it at 125° in a house!

The account goes on to say that on the main land horses are not frequent, and are generally small; asses large; that cattle abound of the humped kind; sheep very small, with fat tails, and fowls very abundant; that Zanzibar is really possessed by the Sultan of Oman, otherwise known as the Imaun of Muskat, and that he has possessions, chiefly nominal, on the main, the rest of the coast being possessed by independent chiefs and tribes, Somali, Galla, Dowla, Wanyekas, and Sowhylees, of whom, however, not much appears to be known. The Portuguese, who had numerous settlements in the 16th and 17th centuries, which they abandoned, do not appear to have left any descendants, and they, as conquerors, have been succeeded by the Arabs. An explanation, however, of the frequent expressions of vagueness and uncertainty is afforded in a subsequent passage in the account, namely, in speaking in reference to the climate, that—

"during the last century and a half no European has resided there [either at Zanzibar or on the coast, I suppose] for any length of time, and therefore no meteorological observations have been made. . . . It is, however, certain that the climate is very unfavourable to Europeans, even where the country is not low and swampy."

Expecting that Horsburgh might add something to the preceding meagre details, I looked into the sixth edition of his 'Sailing Directions,' but there is little to quote. He says Zanzibar has

a beautiful appearance, and is everywhere woody. He mentions that, from religious motives, European ships are not allowed to water from the wells about the town, and that watering at the river should be at low tide, otherwise the water is brackish. Capt. Owen is cited as saying that—

"the crews of all vessels, after having watered at Zanzibar, have been subject to dysentery and fever, which applies more particularly to the river-water, as that procured by digging or from wells does not appear to possess the same deleterious property."

Horsburgh adds that—

"Europeans not seasoned to the climate ought not to sleep on shore if it can possibly be avoided."

The third volume of the Journal of the Royal Geographical Society—in which is an analysis of Capt. Owen's surveying voyage along the E. coast of Africa—affords only a short passage devoted to Zanzibar; a glance over the soundings in Capt. Owen's charts, however, combined with notices of the shores of some of the Zanguebar islands being steep to, with deep water along shore and unfathomable depths a little way off, opens to us a remarkable physical fact, namely, that the surface of these islands consists of nests of corals, perched on the summits of submarine mountains which rise from very great depths.

The British Government have long had a consul resident with the Imaun of Muskat; the consul is also an officer of the East India Company's Bombay army, and agent for the Company at Muskat, and in constant communication with the Government of India. The Indian Government, however, appear to have known so little about the Sultan of Oman, his dominions in Arabia or Africa, and his politics, that in March, 1844, Sir George Arthur, the Governor of Bombay, and his Council, called upon Capt. Hamerton, Her Majesty's Consul and the Company's agent at Muskat, to report, for the information of the Government of India, upon the political relations of the Imaun of Muskat, and to give a concise history of Zanzibar, its climate, form of government, population, trade, products, &c. Capt. Hamerton responded to this call on the 5th of September, 1844, dated Zanzibar; but the report, which is still in manuscript, is chiefly devoted to the history, politics, and conflicts of the Imaun's government.

"The British connexion with the present Imaun commenced in 1803, when he commenced his reign at sixteen years of age, on the murder of his maternal uncle the regent. The Imaun's father had been murdered in 1802 by the Wahabee pirates. The early years of his reign witnessed disaffection, turbulence, and rebellion, until the aid of the English, in 1820 and 1822, in destroying the Imaun's enemies the pirates of Rass al Khymah, and the Arab tribe of Beni boo Ali, gave him some repose, and he was enabled to turn his attention to his African possessions, from which he had obtained little revenue, and that little chiefly from Zanzibar. His subjects on the main land opposed him, and his hostile operations had only the effect of driving them from the

coast, so that his authority is even now almost nominal, excepting at Zanzibar and Mombassa; for rebellion in his Arabian possessions divided his attention, and Restock, the capital where his family had resided for centuries, was wrested from him by his cousin Hamaad bin Azan. The exports from Muskat are wheats, hides, asses, a few horses, dates, and salt; and the imports comprise all the necessaries and luxuries of life."

With respect to Zanzibar and the Imaun's African possessions, Capt. Hamerton says,—

"The Imaun appears not to have estimated their great value; in fact, that the trade on the coast of Africa subject to the Imaun may be considered as not yet fully developed. The principal articles of merchandise to be procured on the main are gum copal, hides, bees-wax, tallow, corn (the Jowaree of India, Holcus sorghum), oil-seeds, some timber, and slaves. The chief articles of export, the produce of the islands of Zanzibar and Pemba, are cloves, cocoa-nuts, and, ere long, sugar may become of importance, as it is understood to be very fine; but as the people want energy, are proud and indolent, and addicted to abominable vices, and are of a mean description, particularly the cross between the Arab and the African, the extended cultivation of the sugar-cane and manufacture of sugar is not of early promise. The imports into Zanzibar are piece-goods, coarse cottons, woollen cloth, muskets, beads, brass-ware, iron, earthenware, hardware, glass, rice, wheat, soap, and candles, and fancy articles in small quantities. The customs are farmed to a Banian (a Hindoo of India) for about 150,000 dollars annually. There are about 500 Banians and between 600 and 700 Indian Mohammedans resident at Zanzibar and at the other African ports of the Imaun, who are the chief traders."

Contrary to all other testimony, Capt. Hamerton says,—

"The climate of Zanzibar on the coast is not unhealthy for Europeans, but it is impossible for white men to live in the interior of the island, the vegetation being rank, and appearing always to be going on, and generally fever contracted in the interior is fatal to Europeans. All fruits and vegetables which grow in tropical climates thrive well."

He adds—

"The damp during the S.W. monsoon is extraordinary. The heat is not at any time of the year oppressive, at least it certainly would not be considered so by people accustomed to the heat of India. It is remarkable, although there does not exist anything like a police, that the crimes of murder and robbery are very rare, but petty thefts are frequent. There are five persons authorized to administer justice, but the best evidence a man can produce of his innocence is *found in his own pocket*."

Captain Hamerton does not mention the size of Zanzibar.

I had lastly recourse to the Journals of the missionaries Krapf and Rebmann, of the London Missionary Society, who are now located near to Mombas, a little to the N. of Zanzibar. These Journals contain a great amount of interesting geographical information; but the primary objects and labours of the missionaries were necessarily not for the instruction of the geographer or physicist, and several days' reading only afforded me incidental notices upon some points of my inquiries; the Journals, nevertheless, open up to us a vast horizon of geographical discovery in

Eastern Africa, of which I may be permitted to say a few words in concluding this paper.

Dr. Krapf would appear to have coasted the Imaun of Muskat's supposed possessions from the Red Sea to 10° S.; the general impression being that the Imaun really was master of the coast to 10° S., but Dr. Krapf says—

"The Imaun of Muskat has not an inch of ground on the coast between the island of Wassin and the Pangani river; this tract in fact belonging to King Kmeri of Usambará down from 4° 30′ to 5° 30′ S. (vol. i. p. 203.—1850.) The tract, which is very low, is inhabited by the Wasequa tribes, and is the chief slave-market for supplying Zanzibar."

As Dr. Krapf embarked from the Pangani river for Zanzibar, after his visit to King Kmeri, he speaks from personal knowledge. He reached Zanzibar in one day, on the 22nd of August, 1850; had interviews with the Imaun and Captain Hamerton, who were then at Zanzibar; on the 29th embarked in one of the Imaun's vessels for Mombas, and arrived on the 30th, the vessel having on board slave boys and girls belonging to a native of Mombas, who were bought at Zanzibar.

Since the above was written Lieutenant Fergusson has transmitted to me, under date 3rd May, 1852, the following account of Zanzibar, condensed from the oral testimony of a Mahomedan merchant of the island:—

"The following information relative to Zanzibar has been afforded by a respectable native of that place, who commands a ship, and is in the habit of going constantly from Bombay to Zanzibar, and *vice versâ*:—

"The island of Zanzibar is situated off that deep bight or bend on the eastern coast of Africa a few degrees S. of the equator. It belongs to the Imaun of Muscat, who is said to be rather partial to the place as a residence; and when his presence is not required at the head of his army, which it sometimes is, to quiet some of the unruly tribes in his dominions, he loves to spend a life of quiet in his palace at Zanzibar, giving himself, however, a change about every other year to visit the town of Muskat, situated on the N.E. coast of Arabia, on one side of the entrance to the Gulf of Persia.

"The appearance of the island of Zanzibar, as approached from seaward, is certainly pretty, having all the charms that the tints of foliage and grandeur of forest trees can give to it.

"The town stands out in bold relief as it comes gradually in sight, although it is not of very great extent. The Imaun's palace and a large mosque are the two principal buildings which attract the eye; there are four smaller mosques, and a very large number of stone-built houses of one story high, and, as in all native towns, the whole is hemmed in by innumerable mud huts, and a common mud wall or fortification.

"In landing the appearance of the town quickly loses all the beauty which a distant view had given to it. The streets are dirty and irregular, the widest being only 20 feet; the others are all lanes. There is no drainage of any sort, either under the town or at the sides of the streets, except at the Imaun's palace and grounds, and the scavenger's duty is a voluntary one, dependent on the inhabitants themselves. There are no public buildings in the town except the arsenal, which is well stocked with arms.

"The Imaun's palace has a fine large drain or sluice running under it, and is

further well supplied with water for the use of the ladies in his harem. The palace is well built of stone, and is three stories high.

"There is also a large wharf at the waterside belonging to the Imaun, and used solely for government purposes.

"The town may be said to be thickly populated, estimated at 200,000 inhabitants, but the majority are very poor.

"Of those that actually belong to the place there are two classes: one, the 'Mizarri,' who are rich, trade largely, and are great landowners; the other, the 'Hŭrth,' a portion of whom are well to do, and others only a few degrees above poverty.

"The number of 'Ceedies,' or 'Moorimā,' is immense, but these come from Africa, and do not belong to the place.

"The actual natives of Zanzibar are tall and lean, but very muscular. The women are only of moderate stature, well made, rather plump, and, in many instances, very pretty. The features both of men and women are well proportioned and defined, with fine jet-black hair and eyes, good teeth, and, in general, small hands and feet. The men all wear beards and moustaches, and the higher ranks, as also many who can afford it, dress very neatly after the Arab fashion; the poorer classes are in a state next to nudity. All classes love indolence, and the men are sadly given to intemperance and lust, but, notwithstanding this, they live to a great age; the average of life with both sexes is 50 to 60; many reach 80 and 90, and some solitary instances of 100 years are to be met with.

"The fecundity of the women cannot be correctly ascertained, as polygamy exists to such a great extent; they are, however, not celebrated for having very numerous offspring, and the average may be taken at four to five children each.

"The law permits only four wives per man, transferable, changeable, or saleable at his pleasure, but more may be had by bribing the priests, who are also the administrators of justice.

"As a man who wishes to engage a wife has to give money to her parents or guardians, according to her beauty, it may be termed, in one sense, 'a purchase.' A pretty girl realises from 100 to 200 dollars.

"Girls are married (*in facto*) at the ages of 13 and 14; the event is always one of rejoicing, and, if the means of the parties allow it, great display, with native music and processions through the town, take place; but the lady never joins the street party, and, in fact, never shows herself to any but her own intimate circle of friends and relatives and to her husband.

"The higher orders of the people are very cleanly in their habits and in their dress, but the lower classes never trouble themselves as to comfort or cleanliness.

"The food of the natives consists of poultry, eggs, dried-salt and fresh fish, mutton, goats' flesh, and rice. No vegetables are grown in the place, but small quantities are imported from other ports. Only one sort of eatable fish (unless the shark be so considered) is caught at Zanzibar, and that is but a small one, black in colour, and without scales, but said to be well tasted. The higher orders only can afford to luxuriate on mutton, goats' flesh, and the fresh fish, these being all dear and not over-plentiful.

"Bullocks, cows, and water-buffaloes are to be had at Zanzibar, but are seldom or never killed for food; they are used to carry loads (but not for draught), and are as dear as 50 dollars each. Horses are also to be had, but not of a first-rate description; they are valued at about 100 dollars each.

"All birds common to places within the tropics are to be found here, excepting the crow, which is unknown to the natives. Hawks, vultures, and eagles are very plentiful. The jungle on the island abounds with black monkeys. The tiger and the rhinoceros are occasionally to be met with, but these, as also the elephant, abound more profusely on the main land of Africa, which is

but a few miles off. A large black snake, about six to eight feet long, as also the cobra, are found in the jungle.

"Some of the trees in the jungle are very large and spreading, and afford good timber; the wood is, however, peculiarly hard and heavy, and will not float in water. It is used for building purposes, both for houses and ships, and its bark is used for tanning hides. The girth of these larger trees varies from 12 to 20 feet. Sandal-wood also abounds; also the wild citron (the fruit is large, but without flavour). Cocoa-nut and palm trees are also plentiful.

"The unhealthy season is at the close of the rains, the same as in India. The only diseases prevalent here are fever and small-pox. There are no professed doctors amongst the natives, and only one medicine appears to be known or used by them; namely, the senna-leaf. The men suffer much from swollen testicles. The natives do not burn their dead, but inter them in graves, as Europeans.

"Within the town there is a very good bazaar, or market, which is supplied with a fair sprinkling of English and French articles; the goods and wares come principally from America, Egypt, Persia, and India. They are not, however, all disposed of to the natives on the island, but are carried into the interior of Africa by the itinerant merchants of that great continent.

"The trades carried on by the natives at Zanzibar are building, carpentering, stone-masonry, ship-building, and the manufacture of inferior cotton goods and trinkets, worn by the inhabitants. We also find goldsmiths, silversmiths, coppersmiths, and blacksmiths. Large quantities of toddy (an intoxicating liquor) are made of the sap of the cocoa-nut, date, or palm trees (*Borassus flabelliformis*), the same as in India, and there is a constant demand for it in the bazaar.

"There are no public schools, or system of education, although the children of the higher orders are taught to read and write Arabic. Some of the natives speak two or three languages, but Arabic is the one generally spoken.

"The whole of the natives declare themselves to be the followers of Mahomet, but their morality is at such a low ebb that they may be considered infidels of the worst order.

"A few European missionaries visit the place occasionally; the natives do not court their society, and they are allowed to exercise their vocations without insult or molestation.

"Zanzibar cannot boast of as many exports as imports; they consist principally in elephants' teeth, dried sharks' fins and tails (caught off the island and coast), sandal-wood, amber, shells, and cocoa-nuts; also a scent obtained from the body of the civet, which fetches a high price.

"From twenty to thirty ships arrive at Zanzibar annually, some American, some French; the rest are native ships from Bombay and Calcutta; but innumerable buggalows arrive from Surat, Cutch, Cochin, the Gulf of Persia, and the Red Sea.

"The slave trade with foreigners is forbidden by the Imaun, on the penalty of death, but amongst the natives it is of usual occurrence, the Seedies, or Moorimā tribe, being bought as servants by the higher orders, who treat them very kindly. The owners of slaves have not the power of life and death over them. A few slaves (principally children) are exported to Persia every year, where they find a ready market.

"The mode of government at Zanzibar is almost necessarily a despotic one; the Imaun having the power of life and death over all his subjects, but which power (to his honour!) he has never misused. In his absence his son holds the reins of government. Justice (if it may be so termed) is administered publicly in the town by the priests, to whom all complaints and all offenders are taken; but their proneness to bribery is so publicly known that a man's doom may be decided by the magic power of money.

"Considering the nature of the people, and the vast population of the place, very few are ever tried for murder; in some years none at all; and the most ever known in one year was only ten. If, however, a man is condemned for murder, he may either give a substitute or the market value of the person he killed.

"To guard the town, and keep peace and order among the people, there are 500 police and 1000 soldiers always kept in the town for this especial purpose. The Imaun's army in Arabia, however, consists of 20,000 men.

"The town is nearly surrounded with water, and there is good anchorage for shipping all the year round. There is also a good landing-place off the town, with a rise and fall of tide of 9 feet. Outside the town-fortifications we find a few gardens, belonging to the Imaun and opulent classes; but it is not safe to venture any distance inland alone, as there are most desperate robbers in the country all round. There are no made roads from the town into the interior, but beaten tracks are here and there visible. The country is flat for a long way in, and the soil is of different kinds in different places—sandy, stony, and in some parts good arable land. Rice is grown by the natives, and plentiful crops obtained every year.

"No precious stones or fossils have ever been found; but most beautiful shells may be gathered along the sea-beach. The hills on the main land are high, but not always visible. The coast is said to be free from pirates.

"E. F. P. Fergusson.

"To Col. Sykes, F.R.S., F.R.G.S., &c. &c. &c.,
East India House, London."

It will be observed from the preceding extracts that nothing satisfactory is known of the topography, geology, number of rivers or rivulets, depth of wells, real quality of the water, forests and forest products, soils, diseases and physical characteristics of the people, and of many other matters of interest to the geographer, the naturalist, and the trader, respecting Zanzibar. In short, a comprehensive and accurate view of the territories of the Imaun of Muskat, whether in Arabia or on the N.E. coast of Africa, is still a desideratum.

With respect to the climate of Zanzibar, it is necessary to preface a consideration of the meteorological records by a notice of the instruments used by the observer, a subordinate but competent medical officer. These were standard and maximum and minimum thermometers for the temperature, wet and dry bulb thermometers for the temperature of evaporation and simultaneous temperature of the air, and a rain gauge. It is much to be regretted that the observer had not a barometer, as the necessarily high tension of vapour would have put to a satisfactory test a theory on the effect of this tension upon the height of the mercury. The observer recorded the direction of the wind and the daily amount of cloud; and in the column of remarks there is the solitary entry of a thunder-storm on the 27th of February.

MONTHLY METEOROLOGICAL TABLE for the Station of Zanzibar in Lat. 6° 28′ S., Long. 39° 30′ E., reduced from Observations made at that place daily during the year 1850 by a Medical Officer under the direction of LIEUT. FERGUSSON, I.N., F.R.A.S., Superintendent H.E.I. Co.'s Observatory at Bombay.

Months.	Mean Reading of the Barometer, corrected and reduced to 32° Fahrenheit.	Mean Elastic Force of Vapour.	Temperature of Air. Highest.	Temperature of Air. Lowest.	Temperature of Air. Mean of all the Highest.	Temperature of Air. Mean of all the Lowest.	Temperature of Air. Mean Daily Range.	Temperature of Air. Mean.	Mean Temperature of Evaporation.	Mean Temperature of Dew Point.	Mean Weight of Water in a Cubic Foot of Air.	Mean Additional Weight of Water required to saturate a Cubic Foot of Air.	Mean Degree of Humidity (Saturation = 1).	Mean Weight of a Cubic Foot of Air.	Wind. Direction.	Wind. Strength.	Rain. Number of Days it fell.	Rain. Amount fallen.	Mean amount of Cloud.	Remarks.
	in.	in.	°	°	°	°	°	°	°	°	grs.	grs.		grs.		lbs.		in.		
January . .	No Barometer observed at Zanzibar.	0·995	87	80	85·7	81·2	4·5	83·3	79·9	78·2	9·95	0·88	0·91	No Barometer observed at Zanzibar.	N.E.	0–4	2	2·70	4–6	
February .		0·791	88	79	86·2	80·7	5·5	83·4	76·4	72·9	8·27	1·53	0·87		N.E.	0–4	1	2·10	4–6	27th. Thunder-storm.
March . .		0·968	88	79·5	85·9	80·7	5·2	82·5	79·8	78·4	10·00	0·78	0·91		Easterly. Variable.	0–2	10	6·31	4–6	
April . . .		1·042	86	78	83	80	3·0	81·5	80·5	79·3	10·35	0·60	0·96		S. to S.W.	2–4	16	16·30	5–6	
May . . .		0·928	83	70·5	79·5	77·6	1·9	78·0	77·5	77·3	9·80	0·16	0·99		S.W. to S.S.W.	4–6	15	39·18	5–6	
June . . .		0·879	82·5	75·5	80	76·8	3·2	78·4	76·8	76·0	9·44	0·10	0·96		S.W. Variable.	2–4	3	0·55	5–6	
July . . .		0·913	81·5	74	79	75·3	3·7	77·1	77·0	77·0	9·89	..	1·00		Variable. S.W. to S.S.E.	2–4	9	3·42	5–6	
August . .		0·891	81·5	74·5	78·8	75·8	3·0	77·3	76·8	76·6	9·40	0·10	0·99		Variable. S.W. to S.S.E.	2–5	6	3·12	4–6	
September .		0·834	82	73·5	79·5	75·3	4·2	77·4	75·2	73·1	8·49	0·91	0·91		S.W. to E.S.E.	2–4	12	3·80	4–6	
October . .		0·855	83	75	81·2	77·1	4·1	79·1	76·4	74·5	9·74	0·85	0·91		S.W. to E.S.E.	1–3	15	11·83	4–6	
November .		0·844	84·5	76	80·8	78·8	2·0	79·8	78·5	77·8	10·01	0·35	0·97		S.W. to E.S.E.	1–4	14	8·39	4–6	8th, 17th, & 19th, Stormy.
December .	(No Observations for December, the person who took them being obliged to quit the place on account of ill-health.)																			

E. F. P. FERGUSSON.

Temperature.—In the year 1850, from the 1st of January to the 30th of November, the extremes of the temperature, as shown by self-registering max. and min. thermometers, were 88° and 73°.5; the former in the months of February and March, the latter in September: the annual range, therefore, was 14°.5. But—

The mean of all the highest readings of the max. ther. for the year was	° 81.8
And the mean of all the lowest readings of the min. ther. was	78.1
Consequently, the mean range for the year was only . .	3.7
And the mean range for the year, deduced from the mean monthly range in the aforesaid months, was	3.66
The lowest monthly range of temperature was in May, when it was only	1.9
The highest monthly range of temperature was in February, when it was only	5.5

Moisture.—The mean temperature of the air for the above period, deduced from the monthly means, was 79°.9, and the mean temperature of evaporation 77 .7; the mean depression was only 22°; and, consequently, the mean temperature of the dew point, by Glaisher's factors, was 76°.6. By Apjohn's formula it would be 76°.85; and as the monthly mean depressions of the wet bulb were respectively—

January	° 3.4	July	° 0.1
February	7.0	August	0.5
March	2.7	September	2.2
April	1.0	October	2.7
May	0.5	November	1.3
June	1.6		

—it would appear, then, that the air in the months of May, July, and August was absolutely saturated with moisture, and it could hold no more water in suspension, and yet in these three months only 30 inches of rain were precipitated; while in September, October, and November 41 inches fell. The greatest monthly mean dryness in the whole year amounted only to a depression of the wet bulb of 7°.0, which would give a dew point by Glaisher's factors of 72°.9, and by Apjohn of 73°.45, with a tension of vapour in the first case of 0.79796, and in the second of 0.81232, balancing, according to a received theory, 8-10ths of an inch of mercury; the highest mean dew point was 79°.3 in April; tension, 0.97903; equivalent to an inch of mercury.

Winds.—The winds, with the exception of the months of April, May, June, July, and part of August (during which the so-called S.W. monsoon may be said to prevail), are the land and sea breezes peculiar to most tropical shores. These latter, however, are said to have no influence in diminishing the sun's heat from those who are exposed openly to it, although

within doors and under sheds, when artificially shielded from the sun's rays, they are most reviving and grateful to the constitutions of even the natives. It is only in January and February that the N.E. wind prevails; resembling, in this respect, the Coromandel coast. In March it is from the E. (variable), and on the Coromandel coast from the S.E. In every other month at Zanzibar the wind is from the S.W. to S.S.E.

Another peculiar feature in the climatology of Zanzibar is that there is seldom any dew experienced; a fact readily explained by the very limited ranges of diurnal and monthly temperature. The air, as the table indicates, always remains hot, and always wet, and there is no sufficient lowering of temperature to cause the precipitation of dew. This quality of the air must be most prejudicial to the health of Europeans, the effects of which have been felt by hundreds in fatal fevers. Indeed, as a seaport, Zanzibar is most insalubrious; and commanders of British vessels have pronounced it unsafe to pass the night on shore, or even to remain on shore after sunset, and many fatal cases, as well as fevers and illness, have been traced to this cause.

Lieut. Fergusson recommends that commanders of vessels or other persons who intend visiting this port should pay great attention to the aforesaid fact, and that care should be taken in avoiding everything likely to derange the stomach, especially alcoholic beverages, as fever of the worst kind is almost sure to follow any derangement of stomach or unnatural excitement of the system.

Rain.—Showers of rain are experienced in every month of the year. They tend to cool the atmosphere while they last; but Lieutenant Fergusson says the after effects from evaporation have an oppressive and disagreeable effect on the lungs.

The fall of rain during the months of June, July, August, and September, the S.W. monsoon months of the Malabar coast, was only 10.89 inches; while during those months on the Malabar coast the fall ranges from 70 to 114 inches; the same wind (S.W.) blowing on the African and Malabar coasts. From the 1st to the 15th of May there was a fall of 39.18 inches, which shows that the full burst of the rain-clouds happens at Zanzibar at about the period the S.W. monsoon commences at Cochin, on the coast of Malabar; but the real S.W. monsoon of Zanzibar would appear to be in the months of March, April, and May, when 61.79 inches fell; months during which in India there is neither a N.E. nor a S.W. monsoon, and the only rain is from a few and uncertain violent, but short, thunder-storms. At Zanzibar, however, in the months of October, November (and, no doubt, December), there is a fall of rain, corresponding to that on the Coromandel coast, of 20.22 inches, although the wind is from the S.W. to E.S.E., but on the Coromandel coast almost entirely from the N.E.

The total fall of rain from the 1st of January to the 30th of November was 97.70 inches; and if we allow December the average due to it in comparison with the other months, we may estimate the annual fall of rain at Zanzibar at above 100 inches. The number of days on which rain fell, exclusive of December, was 103.

Clouds.—The sky seems ever clouded; and after the sun sets there is often a dense haze on the horizon.

In a review of the above meteorological records the following unusual facts appear:—1st. The remarkably limited range of temperature; 2nd. The comparatively high and little-varying mean temperature of the year; 3rd. The extraordinarily continuous amount of humidity, and the consequent very high tension of vapour—humidity so great that in the driest month, February, it amounted to 87 per cent., 100 being saturation; while in every other month of the year it was never less than 91 per cent.; and in the months of April, May, June, July, August, and November, the air may be said to have been constantly saturated with moisture. The measure of this may be appreciated when it is stated that in the driest month (February) it required only the weight of a grain and a half of water to saturate a cubic foot of air. Nothing approaching to these facts occurs on the shores of India even during the monsoons. At Bombay the highest percentage of humidity was 88 in July, and the mean of the year 76, in 1844. At Madras, in the same year, 83 per cent. in December (a monsoon month), and the mean of the year 74½ per cent. At Calcutta, in 1844, in August, the percentage was 94 (in the preceding year, in the same month, it was only 85), and the mean of the year 84 per cent. At Aden, in Arabia, in 1848, the highest percentage was 77½, and the mean of the year 71 per cent. In the table-lands of India the mean annual percentage of humidity ranges from 55 to 60. In India the only approach to the humidity of Zanzibar is met with in the cloud-capped summit of Dodabetta, in the Neilgherries, at 8640 feet above the sea; in October, 1847, a monsoon month, it amounted to 97 per cent.; and the mean of the year was 90 per cent. Not varying greatly from the latitude of Zanzibar, but far to the eastward, in the islands of the Indian Archipelago, Captain Elliott, in his magnetic survey, observed the dew points and the tension of vapour for the few days, or weeks, or months, at which he set up his observatory, and in the following table I have collected the mean maxima of the wet and dry bulb, dew point, and consequent tension of vapour, at the hours at which these maxima occur. Sarawak is nearly on the equator, 1° 33′ N., long. 110° 29′ E.; but the mean maximum tension of vapour is not so great as at Keemup (lat. 1° 22′,

long. 125° 08′), or at Zanzibar, and the percentage or degree of humidity was less than at Zanzibar.

TABLE of the Mean Maximum Dew Points, Tension of Vapour, and Degree of Humidity, from Hourly Observations made by CAPTAIN ELLIOTT, Madras Engineers —Zanzibar excepted.

	Month.	Year.	Dry Thermometer.	Wet Thermometer.	Dew Point.	Hour.	Means of No. of Days.	Degree of Humidity.	Latitude. ° ′ ″	Longitude East. ° ′
Zanzibar . . .	April.	1850	81·50	80· 5	79· 3	Mean of Hours.	30	96	6 28 0 S.	39 30
Sarawak . . .	July.	1846	80· 2	78· 4	77· 8	6 P.M.	27	91	1 33 54 N.	110 29
Sarawak . . .	August.	1846	79· 9	78. 1	77· 5	6 P.M.	19			
Keemah . . .	January.	1848	91· 6	83· 4	80· 8	Noon.	10	83	1 21 55	125 08
Sincapoor. . .	Nov.	1848	81· 7	77· 9	76· 5	2 P.M.	16	85	1 18 32	103 56
Carimon Island .	January.	1846	89· 6	80· 9	77· 8	2 P.M.	6	79	0 59 22	103 27
Padang . . .	January.	1848	90· 9	81· 5	78· 3	1 P.M.	13	83	0 58 58 S.	100 31
Batavia . . .	March.	1847	85· 8	79· 4	76·95	2 P.M.	27	83to87	6 09 52 S.	106 58
Cape Nicobar .	Feb.	1849	87· 6	80· 8	78· 4	1 P.M.	5	84	9 10 12 N.	92 48
Moulmein . .	April.	1849	100· 9	83· 3	76·95	Noon.	7	66	16 29 46 N.	97 45
Cocos Island . .	Aug. & Sept.	1848	83· 8	77· 6	75·15	Noon.	27	84	12 05 38 S.	96 50

The limited and fluctuating periods for which Captain Elliott's observations were made do not admit of any very precise or satisfactory comparison between the continuous records at Zanzibar and his snatches of meteorological phenomena; nevertheless they are approximatively equatorial, although for various months in the year, and in different years, and on the whole we may infer that a difference of from 70 to 90° of longitude does not create any very great difference in the tension of vapour in the atmosphere, but, as far as the imperfect means of judging afford, the atmosphere of Zanzibar would seem to be more continuously loaded with vapour than any place to the eastward; this may not account for the alleged deteriorating effects upon the health of Europeans, and we must probably look to other causes of the unhealthiness of the littoral, not only of Eastern but of Western Africa; the more remarkable as this unhealthiness would not seem to characterise Sarawak, Sincapoor, or Batavia, whose physical accompaniments of low woody land, high temperature, and great moisture do not separate them much from the coasts of Africa.

It does not necessarily follow that the highest temperature of the air and the highest temperature of evaporation give the highest dew point and consequent tension of vapour: witness Batavia and Moulmein; at the former the temperature of the air and evaporation was 85°.8 and 79°.4, and at the latter 100°.9 and 83°.3, yet the tension of vapour and dew point were identical at

both places, viz. .909; and dew point 76°.95; while at neither place was the degree of humidity equal to that at Zanzibar.

Some previous general idea of the climate of a country which travellers, merchants, or navigators are to visit is of much more importance than is usually attached to it. It is quite as necessary that they should not be disquieted by possibly groundless fears, as that they should not expose themselves to unnecessary hazards by a misplaced confidence in a supposed salubrity. In the first case their energies are paralyzed, and what is done is done with doubt and hesitation; and in the second case a career may be cut short, which a little fore-knowledge might have averted. But it is much to be feared that a good deal of the mortality which occurs amongst Europeans in intertropical regions is partly to be attributed to the inflexibility of European habits, which does not admit of a *quasi* adaptation of food, beverage, clothing, usages, and modes of life to those of the natives whom they visit, particularly in a guarded use of stimulants, and in a careful choice of good potable water. A climate, therefore, is not unfrequently wrongly accused, when the accusation ought properly to rest upon the accuser. The average annual loss of the European troops in India is about 5½ per cent., while that of the native troops is not 2 per cent.

Dove, in his 'Isothermes,' has not any records whatever for the E. coast of Africa: he has one, however, on the parallel of latitude of Zanzibar, but 71° of longitude to the E. of Zanzibar: this place is Samarang. The mean temperature of the year is only 81°.87; the difference between the hottest and the coldest months only 4°.10, and the difference between summer and winter only 0°.46—less than half a degree of Fahr. On the Niger, W. coast of Africa, lat. 5° 9′ N., the mean temperature of the year is 85°.27; the difference between the hottest and coldest months 9°.0, and between summer and winter 1°.65. At Madras the difference between summer and winter is 12°.99, and the mean temperature 82°. On the whole, therefore, the unhealthiness of these African littorals must be looked for in other causes than in a constant high temperature and atmosphere teeming with moisture alone. Captain Owen speaks of ships' crews being attacked by fever and dysentery when the vessels have been watered from the river at Zanzibar, but not so if watered from wells; and this offers a plausible explanation of much of the unhealthiness attributed to atmospheric causes alone; for where river water has its sources in rank swamps, or runs through luxuriant vegetation, it may be poisoned by decaying and decomposing ligneous and vegetable matters, and consequently be detrimental to health, particularly to strangers; and this applies not only to the torrid zone, but to all parts of the world where water and rich vegetation are so asso-

ciated. Major Hamerton, contrary to all other authorities, says the coast of Zanzibar is healthy, but the interior unhealthy. The missionaries Krapf and Rebmann, owing to the serious loss of life in their mission, were compelled to abandon the coast of the main and fix themselves upon the mountain of Rabbai, a few miles inland, and both there and in their journeys into the interior they have since kept their health.

I pass now to the third division of these notes, the prospects of African discovery from Mombas, and it will be necessary to give a running commentary from the journals of Krapf and Rebmann upon the bordering territories and their inhabitants. The East African mission commenced in 1844, and its location near to Mombas was accidental. Dr. Krapf had left Zanzibar in a native vessel belonging to Lanios, intending to examine the coast northwards, but having got a little to the N. of Mombas, the captain told him that in case he went farther N. at that season he would not be able to return to Zanzibar for many months, as the wind called Koss or S. wind would soon replace the E. wind, and blow for 6 or 7 months, and he therefore landed at Mombas. But Mrs. Krapf died, and himself and Mr. Rebmann were enfeebled by repeated attacks of fever in 1846, and they in consequence went over to the main land, and at a short distance from the coast located the mission upon the mountain of Rabbai, a shoulder apparently of the eastern edge of the mountainous region which rises into the eternal snows of Kilimanjaro and Kenia, discovered by Krapf and Rebmann upon the equator. Krapf and Rebmann recovered, and they pronounce both Rabbai and the interior from its elevation healthy: nevertheless, on the 30th of June, 1851, Krapf wrote to say the country fever had carried off the Rev. Mr. Pfefferdi, and had driven home the three European mechanics attached to the mission; in short, all who had belonged to it had died or been dispersed. The fever appeared to resolve itself into a low typhus. I gather from Dr. Krapf's voyages along the coast that the inhabitants who fringe it are mostly Mahomedans, forming a thin edging, but that immediately inland numerous Pagan tribes are located—Wanikas, Wakambas, Wasaquas, &c.—and N. of the equator the Gallas encroach upon the Somalis. Of the Wanikas, amongst whom he lived, he says—

"They are great drunkards, revengeful, highly irascible, sunk in venality to a terrible extent, thievish, treacherous, unbounded liars, and very feeble minded." (April 1852, p. 72.) "They marry at 12 or 15, but both males and females are sometimes unmarried at 20 to 25. The same applies to the Jagga of the interior; but the Jaggas have a king, and cheerfully submit to be his slaves. No woman can marry without his consent; and the men serve him as soldiers at his pleasure. The Wakamba, who reside amongst the Wanika, come from 400 or 500 miles in the interior, and remain on the coast off Mombas as agents for their countrymen, and trade in ivory. They have large

flocks of humped cattle, sheep, and the largest goats in Africa, and, as somewhat remarkable for an uncivilised people, they make butter." (March, 1851, p. 56.) "The Wakamba of the interior barter their cattle, sheep, or goats, for ivory, as more acceptable to obtain the cotton cloth, chiefly of American manufacture, beads, brass wire, red ochre, black pepper, salt, blue zinc, kenike, called Nile stuff, and cloths of colours. They have been taught the value of coin, and accept Maria Teresa dollars, which are the chief currency on the coast; also quarter Spanish dollars. On the coast the East India Company's small coin, the anna, has been introduced by order of the Imaun of Muskat. The Banians accept rupees, but at a great depreciation. The Wakamba in no way belong to the Negro, or black Nigrotic race, as distinguished from the brown or Nilotic race from the estuary of the Nile to its sources, and south of its sources as far as the Cape of Good Hope. This race (the Nilotic) differ from the Nigrotic by colour, less projecting lips, less woolly hair, shape of head, &c. The Wakamba have long hair which they twist into strings; they anoint their bodies with butter and red ochre, wear loads of beads of colours on the neck, loins, and ankles: their bit of clothing is over the shoulders, but females wear a leathern apron. The Wakambas have no king or chiefs, but patriarchism or family government obtains. They have not any images or pictures to worship. They use bedsteads of bamboo, made on an inclined plane, and do not sit on the ground, but carry a little chair about with them. They make an intoxicating drink from sugarcane. They kill their enemies, and wild animals, the elephant, rhinoceros, buffaloes, &c., with poisoned arrows. The iron of Ukambani is preferred on the coast to that from India." (March, 1851, p. 59.)

In February and March, 1850, Dr. Krapf made a voyage from Mombas S. to the extremity of the Imaun of Muskat's E. African dominions. He says—

"We anchored opposite several villages near the sea. The captain called one of them Mtotana, where I had the pleasure of meeting a considerable number of Wamamesi, natives of the country of Uniamesi, *in the centre of Africa*, S. of the equator. Literally it signifies 'Country of the Moon.' The people whom I met at Mtotana belonged to the tribe Ukimba; they said they had spent 3 months in coming down to the coast with ivory and slaves. They had their wives and children with them, and lived in small huts which they had erected for their temporary residence on the coast. Their features were by no means ugly; some were very tall. Of the language I understood a great deal, a fact which convinces me *anew* of there being one common language at the foundation of all S. African dialects." (p. 88.)

Dr. Krapf does not say anything of the health of these interior people while residing on the coast. The physical development in height and bulk of men living in equatorial regions, characteristics which Dr. Krapf and Mr. Rebmann observed also in Jagga and Yata, is somewhat remarkable, particularly as Werne, in his ascent of the White Nile, speaks of the inhabitants of the banks beyond the junction of the White and Blue Nile as far as lat. 4° 30′ N. as frequently colossal, with raised noses, and hair no more woolly than that of the Arabs of Sudan, some of the men being really handsome (page 82). These facts regarding the great physical development of inter-tropical races militate against common opinion, and there does not appear to be any counterpart of it on the continent of India, or in the Eastern Archipelago.

Between July 12 and September 1, 1848, Dr. Krapf visited the territory of Usambara, lying S.W. from Mombas, whose king was Kmeri. His route lay along the coast for some distance, inhabited by Somalis and Arabs. Off the island of Pemba, in the district of Pemba, he traversed the Wakurfi wilderness, formerly inhabited by this fierce tribe, extending from the coast of Wasseen and Zanga to the interior of Africa, with only an occasional mount towering over the plain, so that this plain would appear to bound the southern extremities of the mountainous regions of the equator. Dr. Krapf was well received by King Kmeri, and as indicative of the progress the knowledge of European arts is making in these regions, the king, on dismissing him, gave him a commission to send him some percussion caps; and on his return journey, in a hamlet at the foot of Kilulu, he put up with a Wanika, and his host served his food upon porcelain plates, with steel knives from Zanzibar.

Dr. Krapf, neither in his voyage along the coast, nor in his land journey by the coast to Usambara, makes mention of the climate or the health of the people.

Both Krapf and Rebmann penetrated also into the interior at different times to Jagga and Yata for more than 300 miles, and they both pronounce the climate to be healthy from the mountainous character of the country, and its general elevation above the sea, even at a comparatively short distance from the coast. The tribes were friendly, and they found trade carried on with the coast by means of caravans.

Mr. Rebmann has recently visited Jagga, about 300 miles inland from Mombas, in which territory he discovered the eternal snow-capped mountain, called Kilimanjaro, apparently in lat. about 3° S. and long. 36° to 37° E.; and Dr. Krapf penetrated to the Dana river, his route being to the N. of Rebmann's, and somewhat more extensive. At this point he saw another snow-capped mountain, called Kenia, apparently on the equator, and in long. 35° to 36° E. If we now consider this mountainous region continued from Abyssinia and Soudan, with its snow-capped mountains, but terminating abruptly about 6° S. of the equator, there is some reason to conclude that it is the location of the watershed of Equatorial Africa to the N., to the E., and probably to the W.; for the missionaries show that the great Dana running to the E. has its sources in the neighbourhood of the Snow Mountains. The mysterious source of the real Nile, which has baffled the explorers of all ages, and which runs to the N. through so many degrees of latitude, is demonstrably traceable to the same snow-capped mountains of Kenia and Kilimanjaro, for Werne ascended the Bahr el Abiad, the White or true Nile, to 4½° N. lat., and about long. 32°; the stream still running down from the direction of the

newly discovered Snow Mountains. The sources of the White Nile and the Dana, therefore, would seem to be within the comparatively small area of 3° or 4° of lat. under the equator, and the same number of degrees of long. between 32° and 36° E. If we now look to the western watershed of this region, the probabilities are in favour of some of the great western rivers being traceable to it, not excepting even the so-called Niger. Although no European has been to the eastward of Lake Chád in lat. 12° N., and long. 15° E., yet it was ascertained that the Shary entered the lake from the S.E., the very direction of Krapf and Rebmann's Snow Mountains on the equator; and to connect the Shary through the Lake Chád with the Quorra, alias the Niger, we have the authority of Captain Allen, R.N., who, ascending the Niger on the left bank, passed into a river much larger than the Quorra, and with a much greater volume of water, which he ascended for 100 miles, proceeding to the eastward in the direction of Lake Chád—facts which admit of the inference that this river is probably the continuation of the Shary through Lake Chád, and that the sources of the *true* Niger, in common with the true Nile and the Dana, may be found in the Snow Mountains under the equator; for the *minor* stream which runs past Timbuctoo, and has its source in Western Africa, can as little maintain its claim to be the true Niger, against Captain Allen's affluent of greater magnitude than itself, as Bruce's Nile can maintain its claim to be the true Nile since the explorations of Werne and others of the Bahr el Abiad or White Nile. Another important fact mentioned by Krapf, and which is likely to materially facilitate the labours of explorers, is, that one family of languages, with cognate dialects, exists in Africa S. of the equator, excepting I presume the Hottentot and Bushman tongues. With the advantage therefore of ready access to the interior from Mombas, with tribes evidently not hostile to Europeans, from the treatment the missionaries experienced, and with the means of travelling by caravans at least to the Wakambas, circumstances seem to combine to invite exploration in this new field, and doubtless the love of enterprise which characterizes our countrymen will, at an early period, induce some gallant heart to attempt the solution of geographical problems which have baffled inquirers for so many ages past.

VI.—*Account of Two Expeditions in Central Africa by the Furanys.*

Communicated by Dr. Barth, through Charles Beke, Esq., F.R.G.S.

Read Jan. 24, 1853.

I send a short account of two expeditions made by the Furanys, accompanied by a man whom I have already had many reasons to mention in my accounts of Eastern Sudan. This man, the faki Sambo, is the son of a learned Fellani, and author of a history of Haussa. He is himself well acquainted with Iflatún (Plato) and Aristaw (Aristotle), whose works he possesses; and knows the modern history of the tribes and countries where he now resides. He resided a long time in Darfur, at Fayo, one day S. of Ammajura.

Starting from Korio, a market-place about 30 English miles S. of Teudelti, you arrive on the—

1st day at Kirāno, a Fellan village.
2nd ,, Kirro, a settlement of the Beni Hálba.
3rd ,, Nitaega, a village peopled by Fellan and Bornu people.
4th ,, Jakhna, of the Beni Hálba, with their Sheikh Mahe.
5th ,, , a mountain inhabited by the Dajo.
6th ,, Simmama, the seat (about 30 years ago) of Abadima, the governor of the Said.
7th ,, Nyala, a place inhabited by Furanys.
8th ,, Sŏlūj.
9th ,, Ammajura.

This road is the westernmost of the three itineraries collected by me, but does not touch the Jebel Mara, which does not extend so far south as has been supposed. *Direction*, S., a little W.

After he had settled at Fayo the faki Sambo accompanied two expeditions from these southern regions to Darfur, one thirty and the other twenty-eight years ago.

Before giving an account of these expeditions I send a short itinerary from Ammajura to the copper mines, known throughout the whole of the eastern part of Sudan under the name of *el Hófrah*.

1st day Dar Bárra, a district inhabited by the Massalit.
2nd ,, e' Siréf, tarf e' dar, that is to say, the southernmost place of Darfur.
3rd ,, Rijl el Gárret, a standing water in the wilderness.
4th ,, Gosdángo, another resting-place, without constant inhabitants.
5th ,, Augiláko, temporarily frequented by Habbane, and by Fellan cattle-breeders.
6th ,, Ilébo.
7th ,, El Hófrah, a large place inhabited by a mixed population of Furanys, Jellabas, Bornouese, Dajo, Nuba, &c.; close to it are the mines, whence copper is obtained, partly in pure lumps, partly mixed with earth.

Direction, S., a little W.

I now give an account of the *second* of the two expeditions forming the subject of this communication.

This expedition, starting from Ammajura, reached on the—

2nd day Idaera, the frontier place of the southern districts of Darfur towards the west, and the residence of a governor.
5th ,, Serir, a settlement of the Dar el Taasha.
6th ,, Dar Ming, a pagan country, situated to the E. of Rúnga.

9th day Binga, another pagan country, bounded towards the E. by Gulla, that is to say Gulla el Furany, while Gulla el Wadany is situated W.S.W. from Rúnga.

10th ,, Shala, a mountainous pagan country, distant only one day from el Hófrah.

12th ,, Lara, likewise mountainous.

13th ,, Wanga, an extensive pagan country, proceeding through which the expedition arrived on the

17th ,, at a small river flowing eastward, and called by them Bahr el Adda.

18th ,, Dar Bánda, a pagan country of great extent, bordered towards the north by the Bahr el Adda, partly mountainous and partly flat, and inhabited by pagans of light copper colour. Continuing through this country for 20 days, they reached on the

38th ,, Bímberi, another pagan country of less extent, inhabited by a black population. Passing through this flat country for three days, the expedition arrived on the

41st ,, in Kubanda, a large place, extending for about 10 or 12 miles along the banks of a river so large that they could with difficulty make out persons standing on the southern bank, and not fordable. This river runs straight from east to west, and is bordered principally by very large trees called kumba, which bear a fruit similar to the date. They were told that beyond this river there were people with black camels like those of the Rufa; but my informant himself thinks this to be merely a joke. Not being able to cross the river, the expedition retraced its steps from Kubanda. The colour of the people is black.

Direction, as far as Dar Ming W., very little S.; from thence directly S.
Rate of travelling, about 20 English miles per day.

The *first* of the two expeditions took the same direction as the second as far as the Bahr el Adda; but, after having crossed that river, they turned west, a little south; and, passing through Dar Banda in that direction for 15 days, and crossing many watercourses, they entered Bimberi, which country encircles Banda from S. to W. With these people they fought several times, but were not able to make many of them slaves; the enemy fighting desperately, cutting the bodies of the slain into pieces, and carrying these on their heads, in order to feast on them afterwards, as my informant thinks. Having passed the Bimberi they came to several smaller pagan kingdoms, all of which they subjugated, carrying great numbers of the inhabitants into slavery. Still continuing in an almost westerly direction, they finally came to another large kingdom, inhabited by a warlike race, called Andoma. This country was found to consist of a deep sandy soil, flat, and covered with a great profusion of trees, the principal of which were the banana (*mus*), the butter-tree (*tabur* in Bagirmi), and the olive-tree (*zitun*), which my informant, who has resided several years in Egypt, states to be exactly the same tree as that of the coast of the Mediterranean, while the *delēb* was limited to certain localities. In that part of the country my informant saw no river or watercourse whatever. The expedition went on for 3 days, driving the inhabitants before them. When they came to their capital the enemy collected there in such numbers, and fought so desperately with their *korbatsh* or hand-iron, a sort of double axe about two feet in length, entirely made of iron, that the Furanys thought it prudent to retire in as honourable a manner as they could. Sending therefore their interpreter to Andoma, the king, who was seated on a throne constructed of elephants' tusks, laid one above the other, they presented him

with some silken shirts, and made peace with him, but without complying with his entreaty that they should encamp on the spot. On the contrary, having received a present of 10 oxen and 100 fat sheep, they thought it more prudent to make off at a sharp pace towards N. by E., where they came to another pagan country called Mara, which my informant thinks must be near the country of the Bua.

I have now to mention a very curious phenomenon of natural history, which my informant saw on this expedition, though I am unable to make out, from his description, what it really was. Passing the country of Bimberi (?), they came suddenly to a spot where the soil, as my informant expresses himself, was boiling over the water and bubbling up. They therefore called it *Bahr el Ardha*, "the water-stream of the earth."

VII.—*Report on the Return of Lady Franklin's vessel the Prince Albert, under the command of Mr. Wm. Kennedy, from the Arctic Regions.*

Read Nov. 8, 1852.

Mr. President,—It having been ascertained during the spring of 1851 that an important part of the field of search for the missing Arctic expedition could not be explored by any of the ships then engaged or about to be engaged in the service, it was resolved to equip a supplementary expedition for the examination of the portion thus unprovided for. The part alluded to includes Prince Regent's Inlet, and the passages or isthmuses connecting it with, or dividing it from, the western sea, S.W. of Cape Walker, to which latter quarter Sir John Franklin was required by his instructions to proceed in the first instance. This search was assumed to be necessary on the following grounds:—first, the probability of Sir John Franklin having abandoned his vessels to the S.W. of Cape Walker; secondly, the fact that when Sir John Franklin sailed he believed that an open passage was to be found from the westward into the south part of Regent Inlet, according to the chart supplied to him from the Admiralty, and which does not exhibit the discoveries which have been made by Rae and others subsequently to that period; thirdly, Sir John Franklin, it was supposed, would be more likely in retreating to take this course through a country known to possess the resources of animal life, with the wreck of the Victory in Felix Harbour for fuel, and the stores of Fury Beach further north, in view, than to fall back upon an utterly barren region of the north coast of America. Upon these grounds, and in the absence of any information up to that time as to the route Franklin had taken after passing through Lancaster Sound, was founded the necessity of an auxiliary expedition for the special object above stated; and accordingly, in May, 1851, a small vessel, the Prince Albert, was fitted out to

convey a searching party to North Somerset, and the neighbouring seas and islands, and placed by Lady Franklin, from whose private resources the expedition was mainly equipped, under my command. The vessel had been proved well fitted for the service by her accomplishment of a voyage to the Arctic Seas and back in one season, the previous summer, under my predecessor, Captain Forsyth, of the Royal Navy. Equipped for an absence of two years, if required, we left Aberdeen on the 22nd of May, 1851, and after, on the whole, a very favourable voyage across the Atlantic and through Baffin's Bay, reached Leopold Island, on the N.E. extremity of North Somerset, on the 4th of September. Our intention was to proceed from this point to Cape Riley, on the N. shore of Barrow Straits, and at the entrance of Wellington Channel, in order to investigate the traces of Sir John Franklin's party there, of which intelligence had been brought to England the previous year by Captain Forsyth; and thence to Griffith's Island, where Captain Austen and Captain Penny, who had sailed a year before me, had been directed to deposit information of their proceedings. Owing, however, to a long continuance of easterly gales, which had driven all the loose ice in a body up Lancaster Sound, we found ourselves unable to reach either of these points. From Leopold Island to the northern shore a continuous line of densely-packed ice was seen barring Barrow Straits from side to side. A similar barrier, from the same cause, was observed lining the western side of Prince Regent Inlet, as far as the eye could reach. Attempts which we made to enter Leopold Harbour (the wintering quarters of Sir James Ross in 1849, about ten miles to the S. of Leopold Island) and afterwards Elwin Bay and Batty Bay in succession, were defeated from this cause, and we found ourselves compelled, after a circuit of about forty hours along a dead wall of ice, to take shelter in Port Bowen, on the E. side of the inlet. Port Bowen presented so many disadvantages as a winter harbour, all our work lying on the other side of the inlet, that it was resolved, after two days' examination of the coast on each side of it (without, however, finding any traces of its having been visited since Sir Edward Parry wintered here in 1825), to make a second attempt to reach Leopold Harbour, where it was at any rate desirable to effect a landing, in order to ascertain whether any intelligence had been left there by Captain Austen or Captain Penny. After much difficult and perilous navigation among the masses of floating ice, which swept down with great force and rapidity through the channel between Leopold Island and the main land, we succeeded in bringing the ship within a few miles of Cape Seppings, the S. point of Port Leopold; but finding the mouth of the harbour still barred by an impenetrable mass of ice, we were unable to bring the ship in. I resolved,

therefore, to make an attempt to land in one of the boats with four of the men. We reached the shore in safety; but during our absence a sudden movement of the ice had caught the vessel and closed the narrow channel through which we had passed in the boat. After a fruitless struggle of several hours to regain the ship, amongst heavy masses of ice in a state of terrific agitation, threatening momentarily to engulph our little boat and everybody in it, we were forced to return to the shore and there pass the night in the open air, with our clothes a perfect mass of ice and snow. On ascending the high land of Cape Seppings on the following morning our consternation was great at finding no vessel in sight. What had become of her during the night we could not conjecture. We had not much fear for her safety, but as the winter was fast setting in (it being now about the middle of September) we could entertain no hope of her being able to regain Port Leopold that season. Under these circumstances, as our only resource, we pushed on for Whaler Point, on the other side of the harbour, where we were sure of finding an ample depôt of provisions left there by Sir James Ross in 1849. Here we could at any rate pass the winter, and, if no intelligence should transpire in the meantime of the Prince Albert, could still, I hoped, notwithstanding our disastrous separation from the ship, make some progress in the examination of the shores of North Somerset and the neighbouring land, probably as far as Cape Walker. Accordingly, after fitting up the launch, which had been left here by Sir James Ross, as a winter residence, all hands were set to prepare, first, a stock of winter clothing from the blanket bags in the depôt; next, a supply of "mocassins," or travelling shoes, from the canvas housing, which covered the stores, and which formed the only available material in our present destitute condition; and lastly, some snow-shoes, winter sleighs, and harness for transporting provisions. We were in the sixth week of these preparations when, on the 17th October, we were gratified by the appearance of Mr. Bellot, the French officer who accompanied us and has done the expedition so much good service, and seven men from the Prince Albert, which we learned had been driven into Batty Bay on the following day after we had been separated from her, and was there moored in an excellent harbour for the winter. By the 25th of October we were all once more on board, heartily rejoiced to find ourselves again in company with our old shipmates, on whom our long absence had cast a heavier gloom than it had upon ourselves. The remaining two months of the year were spent in the usual preparations for securing and housing the ship for the winter, building snow-houses on the shore for the powder and some of our superabundant stores, and laying in a supply of sleighs, snow-shoes, mocassins, and winter clothing (all of which had to be

made on board) for our intended journeys. On the 5th of January (the first occasion for which we had been long watching), when the ice had set sufficiently along the shores of the inlet to admit of travelling, a detachment of five men, including Mr. Bellot and myself, set out for Fury Beach, with the double object of ascertaining whether this had been a retreating point to any of Franklin's party, since Lieutenant Robinson's visit in 1849, when detached for the purpose from Sir James Ross's winter-quarters; and, in the event of our expectations in this respect not being realised, of making this our first depôt for the more extended exploration we contemplated afterwards carrying out. The sun had disappeared at the ship on the 30th of October, and owing to the position of some high hills to the S., did not reappear till the 13th of February. This first, and all our other journeys during the next two months, were therefore performed chiefly by moonlight and by the guidance of the stars. The use of tents was discarded as a needless incumbrance. However well adapted they may be for spring travelling, I question the prudence of risking men's lives under them, in the terrible temperature and still more terrible snow-storms of midwinter in the Arctic regions. We invariably camped in snow houses, constructed after the Esquimaux fashion, which will be familiar to every one from the prints and descriptions given of them in the narratives of Arctic voyagers. Snow is so perfect a non-conductor of heat that the burning of a common candle in one of these snow-houses creates a perceptible increase of temperature. The heat derived from the flame of a gill and a half of spirits of wine, sufficient to boil a tea-kettle for six men, diffuses an agreeable warmth (relatively at least to the temperature without), which is felt for the rest of the night. Of course great care must be taken to construct the houses perfectly impervious to the air; and this is done by some one within driving a thin rod through every interstice between the blocks of snow which admits the light, while one without follows his movements, plastering every chink over with soft snow, until the whole house is as air-tight as an egg, yet sufficiently porous to admit of the needful ventilation. In our journey to Fury Beach we suffered therefore much less from the cold than we had anticipated. Our greatest difficulty arose from the state of the path, which, winding along the base of the lofty cliffs that line this part of the coast, was often completely impassable, from the accumulations of ice on the beach, until a way had been cut through with the axe. We found the ice in motion also during the greater part of the journey, which we had not anticipated on leaving the ship. It will be unnecessary to occupy the time of the Society with the details of a journey which possesses perhaps little geographical interest. After an absence of seven days we returned to the ship, having

found no indications of any visit to Fury Beach subsequent to that of Lieutenant Robinson of the Enterprise. The stores were all in a state of the most perfect preservation, precisely in the condition in which they had been left by Sir John Ross in 1833. Passing over some unimportant details and various short excursions from the ship which followed our return to it, we left Batty Bay once more, for a more extended exploration, on the 25th of February, looking forward with eagerness to the novelty and various incidents of our long-contemplated journey through the unknown regions to the W. of North Somerset; for it will of course be understood that we then knew nothing of the discoveries of Captain Ommanney, and other officers of Captain Austen's squadron, to the W. and S.W. of Cape Walker. Parties sent out on different occasions had taken in advance six cases of pemmican, six muskets, and a bag of coals. Some pemmican had likewise been left about 10 miles N. of Fury Beach, in January last. Our provisions, clothing, and bedding, and the supply of spirits of wine to use as a substitute for fuel, were placed on two Indian sleighs drawn by five Esquimaux dogs. Our party consisted of seven men, including Mr. Bellot and myself; but on the second day after our departure, Mr. Bellot was directed to return to the ship, to bring up a reinforcement of men and stores to join us at Fury Beach. Owing to the violence of the equinoctial gales prevalent at this season, which kept us a whole week on one occasion detained in our encampment, I did not reach Fury Beach with the remaining five men before the 5th of March. Two days after Mr. Bellot arrived with seven men, making in all fourteen, now collected at this spot. Such was the state of the ground between the ship and Fury Beach, added to the violence of the weather and the obstructions arising from the numerous lanes of open water along the shore, sometimes two miles in breadth, that this short distance made greater havoc in our equipment than all the rest of the journey put together. The damage to the sleighs, snow-shoes, and canvas mocassins, was so great that we had in fact to begin our preparations anew, and send a party of eight men back to the ship for fresh supplies before we could undertake to continue the journey. By the 29th of March our preparations for renewing our march were completed. From Fury Beach we followed the coast-line as far as the bottom of Brentford Bay, where we arrived on the 5th of April. On the 6th we sent back eight of the men who had accompanied us thus far as a fatigue party, and with the remaining six continued our route through a narrow channel leading out of the bay, which, to our gratification, proved to be a strait about 12 miles in length, connecting Prince Regent Inlet with the sea to the W. It appears on the map as Bellot Strait—a just tribute to the important services rendered to

our expedition by Lieutenant Bellot. The land on the S. side of the strait we have reason to believe an island, with another passage, or perhaps more, to the S. of it. The abundance of animal life at this spot, evidenced by the numerous tracks of rein-deer, bears, wolves, and foxes, was such, that I have seen nothing in the whole course of my experience in the Hudson's Bay territories to equal it. In two large openings of the channel seals were also seen in great numbers. We encamped on the 7th on the W. side of the strait, at the foot of a high hill, with still higher hills in the rear, probably the high land seen from Sir James Ross's farthest point in 1849, and named by him Cape Bird. On the S. side of the channel is another conspicuous headland, to which I gave the name of Cape Hodgkin, in honour of my esteemed friend, Dr. Hodgkin, who, I trust, will permit one of a race he has so largely benefited to express this recognition of his unwearied exertions to elevate the condition of the native inhabitants of the Hudson's Bay territories. We had now arrived at a point where, in pursuance of a plan I had the privilege of submitting to Lady Franklin before leaving England, the future direction of our route would be regulated by the circumstances which might meet us here. Had the opening between Cape Walker and Cape Bunny proved a channel continuous with Victoria Strait of Rae, our proper course would have been S., on the probability of Franklin having passed through. On ascending the high land of Cape Bird, however, we observed Victoria Strait, while clear to the S., terminating distinctly, so far as we could see, in a bay, a few miles to the N. of our position. Having made it a rule to lay nothing down on our chart as land which had not been actually travelled over, the connection between North Somerset and Prince of Wales Land of Captain Ommanney does not appear on the map, in which the conspicuous headlands only have been inserted. But that a connection does exist, or if it be broken by any passage or passages out of Peel Sound, that such passages are not navigable, we had no doubt, and accordingly had no alternative but to proceed westward, with a view of ascertaining whether any more promising channel existed farther W., through which Franklin might have penetrated from Cape Walker. We continued accordingly in a due W. course from Cape Bird, across Victoria Strait, and the land forming its western shore, until the 21st of April, when having attained to 100° W. long., and feeling assured that we had got on an extensive tableland—that which I have named Arrowsmith Plains, from the eminent geographer to whom Arctic travellers are so much indebted—and that the very low-lying country over which we had passed must have been mistaken by the travelling parties from the Enterprise, in 1849, for a western sea, we resolved to

walk up to Cape Walker, as well to ascertain whether any channel existed between us and it by which Sir John Franklin could have been led into the field assigned for our search, as to find out whether he had left any intelligence there of his destination. We had hitherto been travelling over a country so uniformly level, that but for the stunted vegetation of a short coarse grass, an occasional clump of creeping willows, and a stunted species of heather, which we discovered on digging up the snow, we might have well doubted whether we were not travelling over an extensive sea rather than on land. Three conspicuous hills, which relieved the monotony of our route, were named respectively, Mount Washington, in honour of Captain Washington, R.N., the compiler of the very useful Esquimaux vocabularies supplied to the Arctic expeditions—Colquhoun Range, after Colonel Colquhoun, of Woolwich, for whose instructions in the use of Copeland's blasting-cylinders in the ice I was much indebted—and Mount Cowie, after the surgeon of the ship. A solitary lake received the name of Fisher Lake, in honour of the Mayor of Toronto, an active and influential friend to the expedition in Canada. From Mount Cowie a due N. course of three days brought us to the S.E. extremity of Ommanney Bay, from which we struck E. with the view of exploring the opening between North Somerset and the land we were upon. We continued on this course until the western shore of what we have since ascertained to be the Peel Sound of Captain Austen's expedition was attained in lat. by account about 73° north. Following the coast-line of this inlet, we reached Cape Walker on the 4th of May. The island on which Cape Walker is situated was examined for three miles on either side of its extreme N.E. point, but we found no traces whatever of its having been visited by Franklin's party. Our stock of provisions was now reduced to what would barely bring us to Whaler Point, on which were placed the stores deposited at Port Leopold by Sir James Ross. This we reached in seven stages more, having suffered much hardship and privation during the latter part of the journey, when, to save time and husband our small remaining stock of provisions, we found ourselves under the necessity of dispensing with our snow-houses, and snatching a brief night's repose, whenever circumstances permitted of its being done with safety, as we best could in the open air. Our whole party had been suffering for some time severely from scurvy, and occupied in administering the remedies for this distressing malady which the stores at Whaler Point supplied. We were detained here till the 27th of May. On the morning of the 30th we reached the ship, after an absence of 96 days, having travelled upwards of 1100 miles. It is needless to say that we had not discovered any traces of Sir John Franklin and his party;

but, although thus unsuccessful in attaining the great object for which we left England, I trust that the result of our exploration, as showing, at least, where the missing expedition is *not*, will not have been without its use as a contribution to the solution of this important and deeply interesting question. Added to the explorations of those who preceded us in the same direction of the field of search, I think they can leave but little doubt that Franklin has not gone by Cape Walker, but taken the northern route, and has proceeded to an advanced W. long., and is now to be sought for from the westward. I cannot conceive the possibility of Fury Beach, as the only depôt known to Sir John Franklin, remaining unvisited up to this time, had his party been imprisoned anywhere in the Arctic Seas, within 500 miles of it. The chief acquisition, in a geographical point of view, of our late expedition has been the discovery of a passage from Regent Inlet into the Victoria Channel of Rae, *thus supplying an important link to prove the existence of a north-west passage along the coast of North America* actually effected by the united labours of British navigators. To this may be added the contribution of some additional facts regarding the various coast-lines and the determination of the physical aspect of the extensive land lying to the W. of North Somerset.

VIII.—*Sir John Franklin, the Sea of Spitzbergen, and Whale-fisheries in the Arctic Regions.* By Augustus Petermann, F.R.G.S.

Read November 8, 1852.

Sir Edward Belcher, having been so fortunate as to meet with an unusually open season, has passed up Wellington Channel, and the search on the track of the missing vessels may be considered to have now, for the first time, actually commenced. It must be borne in mind, however, that it was in 1846 when Sir John Franklin sailed up this channel, and that, wherever he may have been arrested, it has taken him six years—if not lost in the interim—to reach that point. Considering the labour and time required in the search for traces, even of such conspicuous objects as cairns erected only last year,—as have been described in the recent despatches,—one may reasonably assume that it may take Sir Edward Belcher not less than two or three years, even under favourable circumstances, to obtain a satisfactory result in his search.

The circumstance that nothing has been heard from the Investigator, under Captain M'Clure, for the last two years, seems to

suggest that this navigator has not been successful in the region between Behring Strait and Banks Land, and the opinion that Sir John Franklin would ultimately be found on the Asiatic side of the Polar regions becomes more and more probable.

Is Sir Edward Belcher's Expedition to be looked on as exhaustive? and are we to be kept in painful suspense about the missing expedition for three or more years longer? Belcher's, M'Clure's, and Inglefield's Expeditions only comprise one-third of the circumference of that portion of the Polar regions where Sir John Franklin must have been arrested, and the remainder of this region is at present altogether unsearched. As this is just the portion where I consider it most probable that Franklin has been arrested, and also where my proposed route of search is directed to, I am desirous of again drawing attention to my plan, by stating some geographical facts respecting the Arctic Sea directly to the N. of our own shores, surrounding Greenland, Spitzbergen, and Nova Zemla, the scene of the earliest exploits in Arctic discovery and of most important and profitable whale-fisheries.

In the 17th century the Dutch formed the settlement of Smeerenberg on the northern coasts of Spitzbergen, the houses of which were brought, ready prepared, from Holland. This was the grand rendezvous of the whale-fleets, and abounded during the busy season with good inns, and with many of the conveniences and enjoyments of Amsterdam. It is particularly mentioned, that the sailors were every morning supplied with what the Dutchmen regarded as a great luxury—"*hot rolls*"—for breakfast. Batavia, under the Equator, and Smeerenberg, about 10° from the Pole, were founded nearly at the same period, and it was for a considerable time doubted whether the latter was not the most important establishment of the two. But times have changed; these seas have been abandoned by whalers for more profitable regions, and tracts, at one time well known, have become almost "terræ incognitæ."

The nomenclature of these seas is so undecided, the names "Sea of Greenland" and "Sea of Spitzbergen" are so intermixed, that I cannot but think it would be desirable to give each of these names their due locality, especially as the sea between Spitzbergen and Nova Zemla has no name, and cannot be referred to except by long parentheses. I therefore propose, in the following remarks, to call the sea between Greenland and Spitzbergen the *Sea of Greenland*, and that between Spitzbergen and Nova Zemla, the *Sea of Spitzbergen*.

The latter is by far the widest, and is indeed the only *oceanic* opening towards the North Pole and to the chief Polar regions, and on that reason alone may be considered to be the easiest and most practicable of all openings for vessels into the Polar regions.

It is likewise the nearest and most accessible of all the openings to Europe. Nevertheless, arctic writers and geographers have generally assumed an impenetrable ice-barrier to stretch across this sea, and they have pronounced it to be altogether impracticable for navigation. This assumption I consider to be groundless, and as resting upon prejudice.

In supporting my views on this point I need not here call to my aid the elements of Physical Geography, nor adduce recent important discoveries made by the Russians or others, but I will simply draw attention to certain facts contained in published works of the highest authority, by English authors well known and still living,—facts which appeal to the common sense of every person, and can be easily understood.

Captain (now the Rev. Dr.) Scoresby, whose work on the Arctic Regions is one of the most able and comprehensive we possess, seems evidently at a loss, when referring to what I propose to call "the Sea of Spitzbergen." He himself never visited it, not having extended his voyages to the E. of Spitzbergen. His information, therefore, is not sufficiently precise. Still, from what he says directly on the point under consideration, and repeats in one of the Parliamentary Papers of the present year (p. 161), we must conclude that he assumes the Sea of Spitzbergen to be locked up by an impenetrable ice-barrier. Diligently as I have gone over his work, I cannot find a tittle of evidence adduced to prove the foundation for such an assumption. On the contrary, we read the following at p. 180 of vol. ii. :—

> "Some adventurous persons sailed to the east side of Spitzbergen, where the current has a tendency, it is believed, to turn the ice against the shore; yet here finding the sea on some occasions open, they attempted to prosecute the (whale-) fishery, and it seems with some success, a great whale-fishery having been made near Stans Foreland in the year 1700."

Surely a sea where a "great whale-fishery" was once carried on, cannot be locked up by an impenetrable ice-barrier, and cannot be more difficult to navigate than Baffin Bay, or any other seat of the whale-fishery! So far, therefore, as Captain Scoresby's evidence goes, the Sea of Spitzbergen may be considered as navigable.

Captain Beechey, the editor of the narrative of the voyage of Buchan and Franklin towards the North Pole, in like manner, neither directly nor explicitly states his opinion on the subject, but simply records the results of voyages in that region in a clear and conscientious manner, which cannot be too much commended. His octavo volume contains altogether a greater body of information respecting the sea immediately around Spitzbergen than any other work, and a careful perusal of it is indispensable to those interested in the subject under consideration.

In referring those interested in the matter to the work itself, I cannot, however, refrain from citing one passage (p. 349) from a communication of Mr. Crowe, the British Consul at Hammerfest, and establisher and proprietor of a British settlement at Spitzbergen; who says: —

"M. Sharostin, an intelligent Russian, with whom I have frequently conversed, actually passed 39 winters on Spitzbergen, and resided there for 15 years without having once left the island. He declares, that during his residence he invariably found the coasts free from ice for four, and sometimes for five, months in every year. I am enabled to add, that my own vessels have frequently navigated the coasts from Ryke Yse's Islands, the S.E. extremity, round the west coast, to the Seven Islands at the N.E. extremity, and that four times out of six they might have circumnavigated Spitzbergen."

Is it possible that a more favourable prospect for the success of an arctic expedition can be offered than is contained in the preceding remarks? Where is there another portion of the Polar region so near this country and so easily navigated? Spitzbergen extends beyond the 80° of latitude, and forms the highest country in latitude yet reached in either hemisphere,—but where is there another group of islands which can be circumnavigated in a like manner? Compare it to the Parry group, though in latitude 75°, and the difference is obvious.

In short, the assumed difficulties in the Spitzbergen Sea are groundless, and rest upon a prejudice, dating back to the voyage of Capt. John Wood in 1676. The question of the north-east passage had failed to occupy attention for upwards of sixty years, when it was revived by various reports, partly from Holland, but chiefly by the publication of a paper in the "Transactions of the Royal Society of London in 1675," in which it was stated that a vessel had sailed several hundred leagues to the north-east of Nova Zemla, and that the sea was there found free from ice. It was also reported, that some Dutch vessels had circumnavigated Spitzbergen, and that one had even reached the latitude of 89°, and found the sea there quite free from any incumbrance. The subject found a zealous advocate in the person of Captain John Wood, who advanced many reasons in support of his opinion. The enterprise was patronised by Government, and Captain Wood was sent out in the Speedwell.

"The Journal of Captain Wood," Sir J. Barrow observes, "is so meagre that it is impossible to make out his track."

He appears to have held for the coast of Nova Zemla, and had the misfortune, when in sight of it, to run upon a rock and lose his vessel. He was able, however, to return safely to England, when he discredits in the lump all the former instances of having reached high northern latitudes, in the following words:—

"So here the opinion of William Barentz was confuted, and all the Dutch

relations, which certainly are all forged and abusive pamphlets, as also the relations of our countrymen."

This unjust way of dealing, however, has met with the reprobation it deserves by every writer on the subject. The Honourable Daines Barrington says:—

"In justice to the memories of both English and Dutch navigators, I cannot but take notice of these very peremptory and ill-founded reflections made by Wood, and which seem to be dictated merely by his disappointment, in not being able to effect his discovery."

Captain Beechey (p. 295) says—

"The failure of this expedition is attributed by Wood to the error in which he was led by following the opinion of poor Barentz, but in what way we are not told, nor can we easily imagine; for, if that worthy navigator gave any opinion, it would certainly be against the probability of a passage by the route pursued by Wood. Indeed, Wood seems to have been greatly at a loss for an excuse for his failure, as we find him accusing all the statements of both Dutch and English as false, and asserting, in the most unaccountable manner, that Nova Zembla was connected with Spitzbergen on the north, and with the coast of Tartary on the south, notwithstanding it was well known that both its extremities had been rounded on several occasions. In short, he seems to have been determined that, as he could not effect the passage himself, he would create an imaginary barrier which should deter any other person from renewing the attempt. We cannot suppose that these unfounded assertions had much weight in the minds of any sensible persons; but certain it is that the ardour which the subject formerly excited appeared from that period entirely to subside."

Thus far Captain Beechey. Captain Wood, among other things, asserts, in his endeavour to represent those regions as gloomy as possible, that Nova Zemla is covered with eternal snow and ice, and contradicts himself in another place by saying that the soil was thawed two feet deep.

The object of Captain Wood's statement cannot, perhaps, be more properly and correctly interpreted than it has been by Captain Beechey, when he says that Wood was determined "to create an imaginary barrier, which should deter any other person from renewing the attempt." True it is that the interesting problem of the north-east passage was really given up, and has not been revived even in the eras of the most enthusiastic Arctic enterprise. The groundless and false assertions of that unsuccessful navigator seem, ever since 1676, to have influenced the minds of learned as well as practical men, in a degree so as to lead them to consider the only oceanic opening into the Polar Basin as impracticable! And the "imaginary barrier" is even in these our enlightened days held up, by some, as a fact established beyond doubt!

When it is considered that no ice whatever is met with in that region till Bear Island, a distance of 1500 miles from Woolwich, is reached, whence to the 80th parallel there is only 500 miles, and that all this can be performed by a steamer in less than a fortnight at a cost trifling if compared with the millions which have

been spent in Arctic and Antarctic undertakings, and when at so trifling a risk a problem can be solved which, irrespectively of Franklin's expedition, is of the highest geographical interest, and discoveries would probably be made of great importance to the whale-fisheries of the country,—then, indeed, it must be looked on as a disgrace in the history of Arctic navigation, that such an undertaking has not long since been accomplished. The very fact that no suitable expedition has been sent in this direction, and that never any fair attempt has been made to proceed northwards in that sea, ought to have stimulated us to such an exertion. If one only of the eleven vessels, engaged in search of Sir John Franklin in 1850 in Baffin's Bay and Lancaster Sound, had been dispatched in this direction, it would probably have eclipsed, in Geographical discovery alone, all Polar Expeditions as yet undertaken.

The Sea of Greenland has been nearly—what the whalers call —" fished out;" while the whales in the Sea of Spitzbergen have scarcely yet been disturbed. Even in the open waters to the south of the Sea of Spitzbergen whales have been frequently seen in recent times, by British trading vessels on their route to Archangel. Directly opposite, or beyond the Sea of Spitzbergen, on the coasts of the New Siberian Islands, where the sea is very deep, we know that black and white whales occur, and that ribs of whales are frequently found on the land. Prodigious indeed must be the number of whales in the Polar Basin, when their appearance at some of its outlets is considered:—in Wellington Channel the number seen was great, and to the N. of Behring Strait still greater. We learn from a paper printed by the Admiralty, that there have been engaged in the American whale-fishery about Behring Strait, during the last three years, on an average 150 vessels every year.

" All our commerce with what is called 'the East,'" says the Secretary of the United States Navy, " is not so valuable as the Behring Strait whale-fishery. In the first two years, 1849 and 1850 (for which the statistics are returned), more American seamen were engaged in that small district of the ocean than are employed in our whole navy at any one time; in these two years the hardy mariners fished up from the bottom of the sea, and by their own energy created and added to the national wealth, the value of more than eight millions of dollars."

Let the Americans only get the hint of another snug whaling corner in these Arctic Seas and they will not be slow in treating with contempt the fables of the so-called " *impenetrable ice-barriers.*" Will England allow herself to be anticipated—as she has been in the Behring Strait whale-fishery—also in the Sea of Spitzbergen, which is not more distant from the British whale-fishing ports than Cape Farewell, the S. point of Greenland? *

* Spitzbergen is close at home—almost at our very doors—but then Behring Strait is not far from Vancouver Island. The real cause of the decrease of the

And lastly, as to Geographical discovery. When Sir Edward Parry in boats attained the latitude of nearly 83°, to the N. of Spitzbergen, and when the current alone forced him to return, who will deny that that determined navigator might not have reached the Pole, and planted the English colours on that spot, had he had the assistance of steam? The whole of that remarkable voyage only took six months from the River Thames to the latitude of 83° and back, and only cost 9977*l*.* Who will deny that an expedition now sent out towards the Pole through the Sea of Spitzbergen, commanded by an experienced and determined navigator, would not reach the Pole, and make other discoveries, important to commerce and geographical science, even in one single season? The distance from Woolwich to the North Pole is no further than from the same point to Disco Island, and the extent of the *ice-voyage* is in both cases about equal.

Enough has been said to show the importance of drawing attention to the Sea of Spitzbergen as the great opening into the Polar Basin, and, at all events, I cannot but think that, after what has been adduced in the preceding remarks, the investigation of this Sea will be considered as a great *geographical* desideratum, and, as such, I have been desirous of bringing this communication before the Royal Geographical Society of London.

Postscript.

EXTRACTS FROM LETTERS RECEIVED BY MR. PETERMANN FROM CAPTAINS OF WHALING SHIPS AND OTHERS.

No. 1. "In the year 1845, I had the misfortune to have my ship stove, and, in consequence, was obliged to seek a harbour of refuge in Spitzbergen to repair my ship. It was about the 10th of May, and I was in lat. 79° 53′ N., long. 10° E.; it was an unsafe place, but I had no other alternative, and it answered my purpose. The weather was remarkably fine at the time; it was quite evident to the north of us there was a great deal of water, because there was a strong swell in that direction. I have often thought the fish came from the sea between Spitzbergen and Nova Zemla, but dare not take the responsibility to clear up that point. I should be sorry indeed for another nation to take the cause up. I have found, by experience, that the current in the Greenland seas sets to the southward at the rate of 8 miles in 24 hours; in a hard gale from the N.E. I have drifted 20 miles in 24 hours. Drift-wood is repeatedly found as far north as 80°, some of it with the mark of the axe quite fresh upon it; indeed, on the coast of Spitzbergen, large quantities are found."

No. 2. "I found the floes to the east of Spitzbergen quite different from the ice to the westward, it being only like Davis Straits floes, about 4 or 5 feet thick. The masters of the Hammerfest sea-horse vessels told me, that in September all the ice was away, and nothing but clear water on the east side

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British and the increase of the American whale-fisheries may be possibly laid at the door of the different laws of partnership in the two countries.—ED.

* How many hundreds of thousands of pounds, how many lives, how many years, and how many vessels has it not cost to attain only the latitude of 76° on the American side!

of Spitzbergen. I believe we might stop in Greenland much longer than we do; I have been until the 9th September, but I do not see why we cannot continue as long as they do in the Straits."

No. 3. "In 1848, in the early part of May, I was in lat. 82° 00′ N. and in long. 15° 00′ E. In the N. and W. of that point was a complete barrier of ice, but to the eastward, as far as the eye could reach on a clear day, nothing but a sea of water was to be seen."

IX.—*Report on the Return of the Isabel from the Arctic Regions.* By Commander Ed. A. Inglefield, F.R.G.S. (*Gold Medallist.*)

Read November 22, 1852.

Mr. President,—Having at your desire prepared the following account of my recent voyage to the Arctic regions, for the information of the Society, I may perhaps be expected, in the first place, to make some allusion to the circumstances which induced me to undertake such a voyage, when so many vessels were already employed there under Government. Briefly, then, I may state that the Isabel, screw schooner, of 140 tons, had been originally fitted by Lady Franklin, for a voyage to Behring Strait, and that although she was assisted by the subscriptions of the President and Fellows of this Society, as well as by a few other warm-hearted persons, yet by far the largest share of the expense was defrayed by her Ladyship.

This vessel, strengthened, equipped, and fitted with a 16-horse high-pressure engine to work a screw-propeller, having been from unavoidable circumstances thrown upon her hands, she forthwith offered her to the Lords Commissioners of the Admiralty as an addition to the squadron already employed in the Arctic Seas, where from her strong build and easy management she would do important service. Their Lordships, however, declined the offer, and her spirited owner then proposed to *give* her to any competent person who would convey to Sir Edward Belcher the ample store of provision which had been placed on board, and who was to remunerate himself for all further outlay, in seamen's pay, occasional refitments, and foreign expenses, by the sale of the vessel on her return to England.

Though at this time the season was considerably advanced for commencing such a voyage, Sir Edward Belcher's squadron having sailed nearly three months previously, I accepted the offer on those terms, but on the distinct understanding that I might devote my efforts in search of the missing expedition in any direction that I might deem most expedient; and with the further proviso that I should be able to obtain not only the necessary leave of absence from the Admiralty, but also their Lordships' permission to complete the fittings and stores still required for such a voyage at

Woolwich Dock-yard, as nowhere else could they be effected in time. Their Lordships cordially granted my application to that effect, and moreover, ordered a large steam-vessel to tow the Isabel when ready as far as Peterhead Through the generous and active exertions of every body in the dock-yard my little refit and restowage of provisions and stores was completed in a few days, and after swinging the ship at Greenhithe, for the effect of local attraction on the compasses, we left the Thames on the 6th of July, 1852, completed the crew to 17 hands at Peterhead, and finally proceeded on our voyage of hope and zeal on the 10th of that month.

At your last meeting, Sir, I have been informed that an extract was read from a letter of mine written at Disco Island; I need not therefore dwell here on the particulars of that early part of the voyage which preceded the dispatch of that Disco letter, but, after briefly stating the views by which I was actuated when this enterprise was undertaken, I shall at once proceed with a sketch of our progress through Melville Bay.

My inclination would have led me to pursue the proposed *North-East Route*, between Spitzbergen and Nova Zemla; but at the earnest representation of my friends, who considered it as too perilous an enterprise for a single vessel, I relinquished the idea, and turned my thoughts to the examination of that far famed northern sound, at the head of Baffin Bay, which had not only been unexplored by its illustrious discoverer Baffin, but to which he had given the name of Smith Sound, though never within a less distance than 70 and 80 miles. Should I not succeed in this attempt to reach it, or even Jones Sound, I purposed visiting the depôt ship of Sir Edward Belcher's squadron, in the Wellington Channel, and make an offer there of my surplus stores, in compliance with Lady Franklin's original intention; or, if I should fail in that object also, I was determined to return to the southward along the western coast of Davis Strait, and to look narrowly into every creek in the shores of Labrador, in hopes of picking up some tidings of the crews of the two iceberg-borne ships.

The manner in which I have endeavoured to perform these various programmes, besides a searching scrutiny at the Esquimaux settlement of Omenak, the reputed scene of the murder of Sir John Franklin and his crews, as well as into the truth of that mischievous story, I will now endeavour to lay before you and the Society.

Leaving Upernivik on the 16th of August, where we had obtained dogs for our ice chariots, or sledges, I pressed forward with all speed in the direction of Cape York, taking the requisite observations whenever practicable, and connecting the headlands with sketches. A view of the coast extending from Berry Island, which may be always known by a peculiar white streak on its western

side, to Horse Head, will be found amongst the accompanying drawings.

In sailing and steaming through this Archipelago of Islands, numerous icebergs of vast dimensions were encountered, ever and anon splitting with the roar of a thousand cannon, and sending from their reeling bases a swell that was sometimes perceptible at an incredible distance. At the entrance of Melville Bay, the view of which exhibits Horse Head from the northward, with the Sugar Loaf and Devil's Thumb, landmarks well known to the whaler, we passed through a great quantity of drifting sea-weed, and the water abounded with several species of Mollusca; *Clio borealis*, *Clio helicina*, *Cetochilas Arcticus*, and several other species were obtained in the towing net, and with some new varieties were carefully preserved by my invaluable surgeon and naturalist Dr. Sutherland.

Off Cape York a large quantity of sailing ice, as it is termed, was cut through, but a vigorous push under sail and steam soon carried us clear. Two bears that were seen from the crow's nest I succeeded in shooting amongst the ice, and they proved a welcome store of flesh for the dogs.

Passing the Crimson Cliffs of Sir John Ross, which, not expecting visitors at so late a period of the season, were not robed in their scarlet attire, we reached the great glacier of Petowak, to the northward of Cape Dudley Digges, on the 22nd. 180 icebergs were counted from the crow's nest that day, some of gigantic dimensions, bearing rocky burdens of many tons weight on their icy bosom.

Becalmed on a Sunday off Petowak, of which a view with Conical Island and Cape Dudley Digges is shown in one of the accompanying sketches, and being desirous of giving the engine as well as our engineers a day of rest, I allowed the schooner to drift so close to the shore that we could hear voices shouting to us, and shortly after saw several Esquimaux coming down the face of the glacier. Being desirous of learning the exact locality of Omenak, I landed, but with some difficulty from the obstruction offered by the bay ice, which was forming inshore wherever the shelter of a headland protected it from the agitation of the wind.

The fear that our approach seemed to produce at first was soon overcome by certain signs of peace familiar to these harmless people, and a few presents equally soon placed us on terms of the utmost friendship. The immoderate laughter in which they indulged, and the curiosity excited by our clothing, led me to the belief that they had never before beheld Europeans. I vainly attempted to obtain a pilot for the village of North Omenak, but an outline drawn by a woman on the snow with a stone conveyed sufficient information to guide me to the spot. Leaving our new

acquaintances shortly after 6 P.M. we proceeded towards Cape Atholl, which was passed about 8 A.M. on the following day.

Wolstenholme Island, Saunders Island, and the rock close to the shore southward of Cape Atholl, and inside of which we passed, were all sketched, and proper rounds of angles taken to fix their positions more correctly.

A calm day on the 23rd enabled us to steam all round Wolstenholme Sound, till we arrived at North Omenak, where I landed at noon with a party of officers and men, in hopes of being able to sift the truth of Adam Beck's tales.

The village was deserted, but the ample store of blubber, seal and walrus flesh, with divers articles of winter clothing, found in the underground hovels, proved that the inhabitants were only away on their summer hunting excursions. Every grave, hut, and store, as well as everything resembling a cairn, were most closely examined, but no trace of anything European could be found, save the few trifles which I have already laid before you, and which probably were left by H.M.S. North Star, when she wintered there in 1849. One large cairn much attracted the attention of Mr. Abernethy, the ice-master, who had been in the same vessel with Adam Beck when he related the stories that he pretended to have learnt from the natives at Cape York, and asserted that a cairn containing the bones of the murdered crews would be found in the village. When my attention was called to this great heap, nearly 6 feet in height, and composed of large stones, as much as three men could move, I confess that I felt something more than curiosity, and this feeling was not a little whetted when upon removing the upper stones a quantity of bones were discovered, and some of them partially burnt. The cairn was speedily razed to the ground, and a foot deep dug into the frozen soil, and the result was that all the bones were proved by our valuable surgeon to be only whale, walrus, bear, fox, and fish bones; nothing in the least resembling human remains could be seen after the most diligent search, and we gladly left the settlement with a full conviction that not only no such dread catastrophe had befallen our missing countrymen, but that the whole narrative of Mr. Adam Beck was an equally audacious and cruel imposture.

Having made the entire tour of the Sound, and seeing nothing to induce any further delay, we steamed out between the Main and Saunders Island. Two small islands not noticed in the Admiralty chart were fixed by cross bearings, and named after the ice-master, Mr. Manson, who first saw them; and a neighbouring headland was called after Mr. Abernethy, the chief mate. Nearing Blackwood Point, we looked for the two islands with which the chart bars up the entrance of Granville Bay; but finding it perfectly open, we stood in to within half a mile of the shore,

and found it a deep, well-sheltered bay, though there may be a doubt of its possessing any good anchorage. One of my sketches shows its entrance, and the three islands standing off its western shore. Baffling gales three times drove us back from Cape Parry and prevented our doing much on the 24th, but on the 25th good observations were obtained, and the variation of the compass was well determined.

Cape Parry being rounded on the 25th, our exploration of shores which had never been visited, or at least of which no account has ever reached this age, may be said to have commenced. In coasting along the south shore of Whale Sound, we sounded occasionally in 40 to 45 fathoms; and after running for 25 miles to the eastward a party of natives was seen in a bight. We speedily landed, and our communications with them satisfactorily showed, first from their fear, and then from their unceasing laughter and almost frantic gesticulations of surprise and joy, that they had never before beheld Europeans. I walked about a mile to their summer tents, and obtained several curious specimens, which are at your service. The Pot-stone, as it is called, must have been a work of enormous labour and time, when it is considered that the only tools, with which it has been so neatly shaped externally and so expertly hollowed out, must have been other stones of a harder texture.

These people cook their blubber and seal-oil in similar vessels. The knife, the small model sledge, and sledge-dog whip, were all procured at that place, and our returns to that harmless tribe were an ample supply of needles, the thing they most coveted, files, knives, spears, and handkerchiefs, &c. From an eminence of about 1000 feet in height, we could clearly make out that the northern shore of this sound is composed of a group of islands, as shown in the hurried outline I made at that elevated spot.

By midnight we were 6 miles from the settlement, and I was delighted to find that no serious damage had been sustained by the vessel, though she had twice struck on a sunken rock in the centre of the little bay which I named after our zealous engineer, Mr. Bardin.

The several views of Whale Sound, Nos. 12, 13, and 14, and the chart, plainly exhibit the broad strait, with an island in its opening, that leads away to the northward and eastward through a clear open sea, for no land, nor ice, nor ice-blink could be detected between us and the far away horizon. The numerous angles and bearings attached to these views enabled me to lay down, and I trust with some accuracy, the islands that I named after His Grace the Duke of Northumberland, Sir Thomas Herbert, the Earl of Tyrconnel, and Captain Milne; and to give this fair and promising opening the greater geographic interest, I had the pleasure of naming it, Sir, after you, our President, the Murchison Strait.

On the 26th at midnight we rounded Cape Alexander: the sketch will give but a faint notion of the beauty of the scene on this charming polar night. The temperature not being less than 24° was so mild that we hardly cared, on leaving the half deck, where the thermometer stood at 110°, for either hat or extra jacket; the engineer, the stoker, and the men might be seen creeping up the hatchways glass in hand to scan these long looked for shores, along which our hard working little engine was puffing away, and driving us with the aid of a current at the rate of 6 miles an hour. For myself, though I had scarcely left the deck for a whole week, I felt no fatigue, while the excitement of at length finding ourselves in Smith Sound, added to the stimulus of continual daylight, made me and all of us forget the natural hours of rest.

To the fine distant headland seen on the western shore, when rounding Cape Alexander, I ventured to give the name of Prince Albert, as it was on the birthday of His Royal Highness that we first beheld it; and the high range of mountains on the same shore was naturally called after his son, the Prince of Wales.

A strong head wind, which, shortly after entering Smith Sound, obliged us to beat to windward, was now poured out upon us from the *Polar Sea*, and with rapidly augmenting violence. A few hours before that, there was so little appearance of obstruction from ice that it seemed as if we had only to press forward, and even to make choice of our route—either crossing by the Pole into the Siberian Sea, or hauling to the westward shoot through Behring Strait; wild ideas of discovering Franklin, rescuing M'Clure, and succouring Collinson, began to float in my imagination, and as the Polar Basin was now open seven points of the compass, with only one small flat topped island in the interval, we did indeed push onward with all eagerness. A long tack, however, towards the western shore proved that it was encumbered with heavy ice, 12 miles across, with only narrow lanes to work through, and the young ice that was beginning to show itself soon tended to sober my fancies, and to turn my attention towards effecting a landing in order to ascertain the dip, intensity, and variation of the needle in this highest northern latitude that had yet been attained in Baffin Bay. But even these more quiet views were speedily defeated, the breeze freshened to a gale from the N.N.W., and the short but heavy sea occasioned by the conflicting wind and northerly current rendered the attempt impracticable. In vain we sought a smoother landing place, but all seemed equally to defy our approach, and to anchor appeared impossible on this steep coast, as off Cape Alexander we had 145 fathoms within half a mile of the shore.

The gale now assumed a serious aspect, and the ice which it drove rapidly out of the Polar Basin warned us to take more

sea-room for the night. At 6 P.M., therefore, we hove to, under a close-reefed topsail, in the head of the bay; driving amongst bergs and floe pieces, and through a heavy snow drift which obscured all the view.

The storm continued for thirty hours, until the morning of the 29th, when we found ourselves closely beset by ice, having been driven by the heavy northern swell into the lee pack. At this juncture our boiler began to complain, and the rudder to splinter; and as nothing but steam could extricate the vessel from her perilous position, both were quickly secured, while in case of need, ice anchors and whale lines were properly laid out, with her head turned into the right direction for the screw, when ready to act; and when we met together a few hours after at our usual Divine service, there were few amongst us who did not thankfully acknowledge that it did most providentially act at the hour of our utmost need. Thus forcibly driven out of the sea we had pushed forward so vigorously to reach, and the wind still remaining strong and foul, and the double difficulty of returning to the northward in the teeth of the great masses of ice which were driving to the southward, I was compelled to relinquish all hope of wintering in the Polar Basin.

Great was the struggle in my own mind in abandoning that unknown but now open sea which we had explored beyond Whale Sound; but mere geographic discovery was not the only object of our voyage. Higher objects presented themselves—the unabated interest that, in common with the whole nation, I felt in the fate of our missing countrymen, as well as the duty I owed to the noble minded lady who had sent me forth, prevailed—and we endeavoured to turn our back upon that flattering field of promise without a murmur at the decree of Providence, which allowed us to behold, but not to enter this forbidden sea.

Jones Sound, which had been the subject of much attention to those who were conversant with Arctic affairs, and which place it is well known that Sir John Franklin had expressed a desire to explore, was the next object that we adopted, and there we found the same open water which had favoured us to the northward, and which here yielded an easy access to its interior.

On the 30th of August we ran through Glacier Strait, and passing Coburg Island and Kent Islands, our sketches and bearings enabled us to correct their very erroneous positions.

By the 1st of September we had reached to 84° west longitude, in the neighbourhood of an island with a noble peak, which was named after Sir Robert Inglis, and round which the coast of Ellesmere Island turns suddenly to the N.W., while that of the North Devon shore, on the southern side of the sound, continued its westerly direction, until lost in the distance. It is to be specially

noted, that no western land was seen to close up this sound, and therefore, that though it may possibly curve round into the Wellington Channel, or receive a branch *fiord* from Talbot Inlet, yet there seems to be great reason to suppose that it offers one more entrance into the Polar Basin.

At 2 P.M. of the 1st, we were enveloped by a thick fog, which prevented our examining the farther shores, either for cairns, or beacons, or for a safe winter harbour for ourselves, or even for a temporary anchorage. The lateness of the season showed that we could not afford to loiter there, and a dead foul wind, down the sound, offered no hopes of a speedy solution of the extent or nature of this great and, let me add, interesting inlet; while a falling barometer, increasing gale, and threatening sky, though leaving me no time for much deliberation, yet called up a few unselfish thoughts of what I owed to the care of the people who had committed themselves to my guidance. These reflections determined me no longer to run the risk of being beset in such a place, and I therefore ordered the helm to be put up and ran out along the southern coast. The heavy sea which was breaking round us prevented all chance of landing, but we kept in shore as closely as possible, and at every lift of the fog our glasses carefully scanned every object in view. The following day at 2 A.M. we found ourselves a mile from Cape Parker, where we were suddenly surrounded by floe-pieces, 26 and 30 feet in thickness; but luckily we were able to take advantage of the lanes and openings that presented themselves, and by the aid of our steam a few hours released us from a very perilous situation; where if we had been caught by an easterly wind, the little Isabel would have inevitably been crumpled up like an eggshell.

Now came for immediate decision the important question What are we to do next? Should I shape my course along the west coast of Davis Strait, the examination of which I felt myself almost pledged to attempt; or should I communicate to Sir Edward Belcher our northern discoveries, with which it would be important for him to be acquainted, as they might possibly influence his future operations? The rapid advance, however, of the season and the work that I still hoped to execute were indeed urgent reasons for repressing this desire, and for resisting the great pleasure we should all feel in delivering at Beechey Island the many letters with which we had been charged for his squadron. But to counterbalance these considerations my mind dwelt so strongly on the satisfaction it would afford the British public, and all the Arctic connected families, were we to carry home such late accounts as we should be enabled to do by returning this year,—and so I determined on making the attempt.

Light and variable winds prevented our reaching Beechey

Island till the 7th of September—and dreary and desolate in the extreme did this far famed spot appear, as we steamed slowly in, with the bows of our vessel many inches thick with ice, and our hearts yearning towards the brave fellows who had spent their winter here waiting for the time to make a bold dash into the mazes of unknown channels and ice-bound shores. We remained there only long enough to collect the latest accounts of the searching squadron, as well as of the brave Kennedy's exploits; and at 12 P.M., as soon as the North Star's letter bags were packed, we left the bay under sail and steam.

To the west coast of Davis Strait, all my attention was now to be devoted, and after some delay from a violent gale with a cross sea from the eastward, we proceeded in that direction; and I may here mention a curious instance of the difficulties that assail an incautious mariner in these regions from the defects of his compass, and from the extreme weakness of the horizontal magnetic attraction. Being off Mount Possession on the 12th, a thick fog suddenly concealed the land, and at sunset we were working to windward against a stiff breeze from the southward. Neither land nor stars could be discerned, and it was not until nine the next morning that we discovered the wind to be then from the northward, having chopped round during the night, throughout which we had regularly continued to tack every three or four hours.

At Cape Bowen I landed, and obtained some observations for the dip, and erected a cairn; but nothing was seen to vary the monotonous extent of ice and snow, save one huge bear, and a poor little fox.

At Cape Adair we endeavoured again to reach the shore, but the brash ice defied our best efforts. Here and all the way down this coast we fired occasionally a 12-pounder, and every night threw up rockets at intervals.

At the River Clyde our southern progress was arrested by a broad field of ice, which seemed toggled on to the shore by a line of lofty bergs which had grounded on the Hecla and Griper banks. This ice forced us far away to the eastward, and in 71° 12′ N., and 61° 30′ W., we were driven into the pack, but after struggling for two days and one night we succeeded in again plunging into open water. The pack, however, afforded us some amusement, as we chased and killed three more bears. No sooner, however, had we extricated ourselves from the ice, than we were assailed by a succession of the most furious gales I had ever witnessed. The first lasted for 6 days, and drove us 100 miles to the northward; when a want of water and some little damages obliged us to go into the Hunde Islands, from which place we sailed on the 8th of October again to encounter a strong gale from the southward. On the evening of the 9th it veered round to N.E.,

and before it we scudded, until it had freshened to a tremendous gale, with a frightful following sea, which sometimes swept the deck fore and aft, and obliged us to carry not only a heavy press of sail, but eventually scud until we could not safely heave to.

In this condition we passed Cape Walsingham and Cumberland Sound, into which I was anxious to look, with the view of wintering in Hogarth Inlet, where I could advantageously carry out several series of useful observations, and from whence I hoped to continue and complete a diligent search of the coast from the River Clyde to the Meta Incognita of the Charts, which thereabouts seem to be all guesswork.

October 13th brought some little improvement in the weather, but now we had been forced past our port, and my ice-masters, both old experienced Arctic voyagers, earnestly begged that I would relinquish the attempt to get in with the western coast at this late period of the season, declaring that the coast could not be safely approached but in fine weather, and that every thing now showed the winter to have fairly set in. After waiting two days longer in hopes of a change, I yielded to the advice of these two ancient mariners, and putting up the helm for England, arrived at Peterhead in four months precisely from the day we sailed; having during that period reached a higher degree of latitude in these seas than any of my predecessors.

Places named in Map.—Isles: Manson, Three Sister Bees, Northumberland, Herbert, Milne, Tyrconnel, Prudhoe, Sutherland, Littleton, Louis Napoleon, Mittie, Coburg and Kent, Cone and Smith.—*Capes:* Abernethy, Alexander, Robertson, Albert; Crystal Palace Cliffs, Camperdown, Sabine, Cracroft, Wade, Frederick VII., Douglas, Faraday, Norton Shaw, Macdonald, Waldegrave, Hardy, and Newman Smith.—*Heads:* Victoria, Stafford, Dunsterville.—*Points:* Thelluson, Gale, Paget, Bence, Boger, Sir R. Inglis, Maxwell.—*Mountains:* Prince of Wales, Leeds, Bolton, Glentworth.—*Straits:* Murchison and Glacier. —*Bays:* Princess Marie, Lady Franklin, Hyde Parker.—*Bight:* Thorold.—*Inlets:* Cadogan, Talbot.

X.—*On the large Continental Ice of Greenland, and the Origin of Icebergs in the Arctic Seas.* By Dr. H. RINK, of Copenhagen.

Communicated by Dr. SHAW.

Read May 9, 1853.

IT is a well-known fact that all the ice formed from snow upon the surface of land, where the heat of summer is incapable of melting and preventing its gradual increase, has a tendency to extend and move downward, as water would do, according to the same laws, in case rain instead of snow had fallen upon the surface. Those masses of snow accumulated in high regions of mountain chains, even in the hottest parts of the globe, gather in the valleys, which thus form the natural drainage for the highlands, and being congealed into a compact body of ice, move slowly down into lower

and warmer regions, till the increasing heat, by thawing them, sets a limit to their further spread. These masses of compact ice spreading down through the valleys or clefts, and constantly furnished with farther supplies by the snow accumulated in the surrounding highlands, are, in Europe, seen on the largest scale upon the Alps, where they are known under the name of "Gletcher," or glaciers. It is manifest what an important part they perform in the economy of nature by carrying down into warmer regions the annual excess of snow and ice, which, without these means, would continue to increase perpetually on the tops of the mountains. The height at which snow can lie from one winter to another, and form perpetual ice, is very different in different latitudes and climates; but the depth to which the glaciers are able to carry down the annual excess of perpetual ice is, moreover, dependent on the height and extent of the snowy regions from which it receives its supply. In the Alps, the lowest glacier line is 3600 feet above the surface of the sea. In the Polar regions primary snow and ice are found lying at much lower levels than those to which the glaciers descend in the Alpine regions, so that glaciers frequently reach down to the very surface of the sea, or *even below it*. But the ocean surrounding the coasts of those Arctic regions presents a far more striking phenomenon in the masses of floating ice, called icebergs. We shall hereafter have occasion to speak of the nature of these masses, and the conclusions drawn from them as to their origin; but here we will merely briefly rehearse the common observations of travellers who have navigated the seas of Greenland on both sides. The larger icebergs rise above the surface of the sea to the height of from 100 to 150 feet and upwards, and some are 4000 feet in circumference. The part *above* can scarcely be considered more than one-eighth of that *below* the surface of the water, so that the cubic contents of the iceberg may amount to 100,000,000 of cubic ells, or about 66,000,000 cubic yards; a fragment of ice, which, if we suppose it to be fairly landed, would form a mountain about 1000 feet in height. All agree that the icebergs of these Arctic seas are originally formed on *terra firma* from the snow and rains which, from the severity of the climate, are never able to reach the ocean in a fluid state, but which, in the course of years, are transformed into a mass of ice, and are then, through some physical agency, thrust forward into the sea. But now the question arises, in what country have such crusts of ice been met with? and how have they been seen to detach such huge fragments so far into the ocean as to enable them to float? To those who have described these icebergs, on seeing the high coasts of Greenland and Spitzbergen, with their mountain tops perpetually covered with ice and snow, and in many places the ice from the highlands extending itself into the valleys and filling them to the very sea-

shore, where the steep icy walls are chafed by the waves, and small fragments are broken loose and thus set adrift on the surface of the water, it very naturally occurred that the icebergs might derive their origin from such gletcher (glacier) valleys. This opinion has been entertained by all who have observed glacier (gletcher) valleys, as well as floating icebergs; but at the same time it would seem strange that the most experienced navigators of the Polar seas have never mentioned seeing an iceberg protruding from the shore, or the glaciers in the act of detaching fragments from their mass, which in any degree could in bulk be compared to an iceberg, although the number of these, which unquestionably are produced in the Polar regions every year, is so surprisingly large. It is also with good reason that Scoresby wonders that icebergs are so rarely met with in the neighbourhood of Spitzbergen, although that Polar land is said to be particularly distinguished by its numerous glaciers reaching down to the sea; while, on the contrary, icebergs are far more frequent in Baffin Bay. He explains this difference by the different nature of the coasts in both places; but it will be our business, in the subsequent pages, to show that a much more essential cause produces this difference—a cause to be looked for in the nature of those tracts of land in which so great an excess of ice is produced annually. The author of these pages, during a residence of several years in Greenland, enjoyed an opportunity of becoming acquainted with the seven northernmost Danish settlements, *i. e.*, that part of the E. coast of Baffin Bay which lies between 68° and 74° N. lat., and from which, in all probability, a great number of the largest icebergs, which pass down Davis Strait, issue. He has thereby been led to adopt a view respecting them, with reference to which he preliminarily begs leave to propound the following main points, before he proceeds to establish it by detailed proofs deduced from the local circumstances of the coast above alluded to.

1. Where large icebergs proceed from the coast, they regularly issue every year in large numbers from places *in extent about 4 miles*, so that the annual production of ice amounts to thousands of cubic yards, but occasionally leaving interstices from which few or no icebergs are sent forth for some time. Considering that in other neighbouring tracts the snow and rain reach the ocean in a *fluid* state, with few exceptions, this quantity is far too great to be reproduced only by the yearly increase of ice in the hilly region immediately surrounding a solitary valley or ravine. As the glaciers in such valleys or ravines correspond to, or take the place of mountain streams, the places, from which the icebergs proceed, represent, as it were, the mouths of rivers, carrying off water from a large tract of upland. The ice thrust forth into the sea, in the form of massy mountains, is originally formed over an enormous extent of country, from whence it, by an agency similar

to that by which the progress of glaciers is effected, is thrust forward to and brought to a point at the place from which the icebergs proceed. For the formation of icebergs accordingly a tract of land of a certain extent is necessary, in which the sea forms so few and small creeks or inlets that rivers or watercourses of some magnitude must necessarily be present.

2. Where the above-mentioned condition exists, in conjunction with the necessary temperature of the climate, the formation of ice does not proceed from certain mountain heights, but *the whole country is covered with ice to a certain elevation; mountains and valleys are levelled to a uniform plane; the river-beds are concealed, as well as every vestige of the original form of the country.* A movement, commencing *far inland*, thrusts the outer edge of this mass of ice forward towards the sea; and when it reaches the frith, it may be seen to sink, and to diverge and even extend out several miles. There the agency of the *obliterated rivers* may be observed in the greater or lesser rapidity with which the matter in a solid state is carried forward to the ocean. The massy crust, *still preserving its continuity*, proceeds from the shore, borne by the sea, until some circumstance or other destroys the equilibrium, and breaks some fragments off the outer edge, which is again thrust forward, and again detaches new fragments, thus continually renewing the supplies from the interior.

3. A tract or *body of land of the requisite size* is, in the northern hemisphere, *only to be found in Greenland*, and more especially in that part which lies to the N. of the Arctic Circle, where in the interior, beyond the inlets of the sea, the country increases in breadth from E. to W., and affords space for the original *birthplace* of these large icebergs. Neither Spitzbergen, nor the narrower parts of Greenland, nor the peninsula nor the islands which surround it, are adequate in size to produce the yearly excess of indissoluble ice which, *from that large and unknown continent, is very slowly protruded;* and, as it seems, in a lesser degree toward the eastern shores of Greenland, along which the icebergs are driven past Cape Farewell, the greatest quantity going to the W., into Baffin Bay. The friths or fiords, which, piercing far into the country, receive and transmit the icebergs, are called *ice friths.*

The aforementioned tract of coast along Baffin Bay, to which we will confine our present remarks, and which is exhibited in the subjoined map, is particularly characterised by the deep inlets and branches of the sea—by that mixture of land and water—that labyrinth of peninsulas and islands—by that peculiar configuration, which provides the means of subsistence to the inhabitants, and thus altogether supplies their nourishment from the ocean.

From the outermost isles, these arms of the sea commonly reach from 50 to 100 miles inland, *where every one of them terminates*, and where the body of continental land commences, a vast region

completely destitute of animal life, and buried under a continuous tract of ice, which only terminates about 800 miles more to the E., in the high unknown latitudes of eastern Greenland. Let us suppose now a line drawn from S. to N., touching the inner extremities of all the deep inlets, and let us call the group of peninsulas and islands, which lie to the westward of it, the *outskirts* of the land, and the compact continent to the E. the *inland*.

The area of the outskirts of N. Greenland may be estimated at about 30,000 square miles. But the above-mentioned divisions, with their numerous ramifications of inlets and bays, cause it to spread over a far greater surface. If we at the same time consider its thin population and severe climate, it is no matter of surprise that this part of Greenland has been hitherto so very little known, and that there exist large tracts of country unvisited but by a few natives, and difficult to classify, either as islands or as attached to the continent. Most Europeans leave Greenland without even having seen the extensive and uniform *table-land of ice* which spreads its waste tract over all the eastern regions, and without having ever visited the termination of the fiords into which this ice annually throws off its enormous excess in the shape of colossal fragments, amounting to many millions of cubic feet. The places where such mighty and extraordinary natural phenomena take place are, generally speaking, far removed to the eastward from the inhabited coast-land, and all access to them over the inlets and friths, on account of the extraordinary accumulation of drift-ice in summer, and the breaking up of the solid salt-water ice by the motion of the glaciers in winter, is rendered difficult and dangerous in the extreme for the explorer. But at the *mouths* of the icy friths we have an opportunity of observing the masses which annually pass off into the ocean, and we are then perfectly astonished and wonder-struck when we reflect in what parts of the country such stupendous quantities of ice can have been produced and flitted down to one single inlet. In considering the *outskirts*, nothing meets our eye that would indicate any cogent reason for such an accumulation of ice even in that severe climate. We observe on these 2000 square miles of islands and peninsulas the snow and ice of a whole winter lying below the level of 2000 feet, annually thaw away before the heat of the sun in the month of June—a summer heat sufficient to produce the vegetation of several hundred species, which blossom and produce ripe seed before the frost of the subsequent early winter causes them to fade at the latter end of August. This heat would probably be sufficient to thaw double or triple the mass of snow produced by the preceding winter, before the commencement of the fresh accumulations of its successor.

Although the *mean* temperature of the year on this coast is some degrees below the freezing point, we here find the ordinary

law of nature maintained; according to which, even in warmer climes, the formation of perpetual snow and ice is dependent upon a certain elevation over the surface of the water: but here *this elevation* is of course less. All observations made on this subject lead to the result, that somewhat above 2000 feet is the lowest elevation at which a crust of perpetual ice can be formed in this country, and that this highland-ice no doubt may spread in ramifications through clefts and valleys to the lower country, and in some instances even down to the ocean, but that the ice formed at such an elevation, with the exception of very few cases, is only temporary. Neither do we find at the elevation of upwards of 2000 feet *perpetual* ice and snow in *every* place. On the contrary, below the 71st parallel of N. latitude, phanerogamous plants have been found at the elevation of 4500 feet. Further it has appeared, that the ramifications of the highland-ice or gletchers here, as in other climes, have a *progressive* movement. This movement is, however, extremely slow, and the increase of temperature in the lower regions often melts away their lower edges, so that only a few of the largest gletchers, which receive their tribute of ice from a great tract of highland, have been able to reach the coast; but the dropped fragments of ice (singularly called by the Danish colonists *calf-ice*) sent forth to the ocean by these glaciers, are so inconsiderable, that it may be safely asserted that the sum total of rain and snow, which in the course of the year falls on the *outskirts*, leaves them again in a *fluid* state. At the same time there is an observation, founded on experience, which may clear up these apparent contradictions, that the neighbouring *inland* continent is not only formed into a perfect level of ice, but also yields a large excess thereof to the ocean. It is of course manifest, that even in the low country there might be formed a crust of ice altogether indissoluble, if only the requisite quantum of water in due form was exposed to the action of the annual frost of eight months. This does not take place on the fresh-water lakes, where the ice rarely attains more than 6 feet thickness, owing to the protection afforded by the ice itself, as well as by the snowy carpet, against the frost. If, on the contrary, through the course of a whole winter, water were constantly poured over a surface perpetually exposed to the action of the atmosphere, there would no doubt be formed a crust of ice 20 to 40 feet thick, which the short summer would be incapable of melting. We see an approximation to this in several parts of the *outskirts*, where running water continues its play during the winter. When the snow in all other places is thawed away, we observe thick crusts of ice in the neighbourhood of certain water-springs, which continue running *throughout the year*. Nay, even near the sea-coast such a formation of ice is found, which has never been known for a certainty to have entirely melted. This,

moreover, is the case at the mouths of all the larger rivers, more particularly where they spread over a delta, the bed of which is formed of large stone blocks. Such rivers may, during winter, be fed with water, either from water-springs or from lakes, whether their outlet be direct or subterranean. The main point is, that the larger the territory the more difficult it will be for the water, which is received in the course of a summer, to gain sufficient time to reach the ocean *before the winter frost begins to stop it in its course.* But the *inland* region is particularly distinguished from the *outskirts* by the great extent of its water-courses, and by the distance over which the water must pass before it reaches the ocean. The old rivers may thus have been stopped in former times, and filled the valleys with ice, which again may have blended itself with that from the highlands, by which the icy covering of the whole was effected; but now this covering has extended to a height at which the above conditions for the formation of highland ice are rendered unnecessary.

The exclusive origin of the icebergs from the inland ice, through the icy friths, has been mentioned; but where these friths have a certain extent in an *easterly* direction, we find those valleys which ought to form their eastern continuation everywhere full of ice; and when, from a considerable elevation on the mountainous parts of the coast, they may be viewed or explored by vision, we observe that they rise, and at the same time *approach and unite,* in an icy level, occupying the whole of the eastern tract, or area of the continent. The elevation or height above the sea of this icy plain, at its junction with the *outskirts* of the country, and where it begins to lower itself through the valleys to the friths, is, in the ramifications of the Bay of Omenak, found to be 2000 feet, from which level it gradually rises towards the interior. The author has *in his journeys observed twenty-three such icy steps,* or platforms, to which must be added five or six delineated according to description. But although the icy level or plain, from which they appear to have their common origin, appears everywhere to have a uniform descent, there is still observable this remarkable difference, that certain of its ramifications are protruded with far greater force into the friths than others. This movement can be measured partly by the power with which the solid surface-ice in the bays, during winter, is broken through or disturbed in its usual structure and position, and partly and more particularly, by the quantity of ice which, in the form of *calf-ice,* and of icebergs, is annually produced, and carried through the icy friths to the ocean.

An estimate of the quantities of ice annually transported by the icy friths, which have partly been observed by myself, and partly derived from the information given by the inhabitants, has con-

vinced me of the existence of five principal ice-friths on the coast-line, from 67½° to 73° N. lat. From these nearly all the large icebergs are produced, and every one of these inlets receives annually from the inland icy region many thousand cubic feet of ice. The principal ice friths are as follows:—

1. That of Jacobs-haven, in 69° 10′ N. lat.

2. Of Tossukatck, behind the island of Arvemina, in 69° 50′ N. lat.

3. The large one of Kariak, in 70° 25′ N. lat.

4. The still larger one of Kanyeidbursoak, in 71° 25′ N. lat., both being ramifications of the Bay of Omenak.

5. And of Upernivik, in 73° N. lat., behind a large group of islands.

In considering the manner in which the ice moves from the interior down into the ice-friths, and its breaking up there; and how the *calving*, or liberation of the floating icebergs, is effected, the following special remarks may help to explain and illustrate the earlier views formed on the subject in different records of travels. Remembering that all icebergs are fragments let loose from the continental ice, it cannot be doubted that the parent mass must at least have been the thickness of the iceberg's smallest diameter. Accordingly the ice, which is pushed out from the interior through a valley into a great ice-frith, must be considered a plane body of at least a thousand feet in thickness; * on account of the brittleness of the material, this down-gliding motion cannot take place without violent disturbances, on which account its surface resembles a peaked, waved, and suddenly-congealed sea, which, besides, is cut through by numerous rents. In the meanwhile this weighty plane body preserves its continuity in progressive motion over the old beach on the bottom of the sea unchanged as when on shore, till the outer end has reached a depth in which the water begins to bear it up, where, still preserving its connection, it proceeds, thus borne up by the sea, till some exterior cause makes the connection cease, when the outer end breaks off and becomes a floating iceberg. This action is called *calving*, and such is the concussion, that it sometimes sets the sea in motion to a distance of 16 miles. From the above it is evident that icebergs cannot be considered as breaking off from the coast; it would be more proper to say, *that they rise* out of the sea; for in general the icebergs, advancing in front of the continental ice from whence they proceed, are higher at the inner end than at the outer end, which seems to be somewhat pressed down by the part behind, while it is gliding down the rocks at the bottom. Continental ice, or gletchers, which are exposed to much action of the sea,

* Most icebergs are upwards of 1600 feet thick, and draw more than 200 fathoms water.—F. B.

produce only *small ice-calves*, and *no icebergs*, or, at best, of small size. It is uncertain whether the continental ice advances gradually and regularly, or periodically. Its breaking or calving is altogether independent of this, as it seems to depend on outward causes, in such wise that the station or limit, to which the outer end may attain, is uncertain, and may sometimes proceed much further *without breaking* than at other times; so that even in the severest part of the winter it may send off large icebergs into the ocean. From November to June the water, in which the icebergs are to proceed to the ocean, is so covered by the ocean ice, that they are shut up in the inner ice-friths; but in July, and especially in August, they are carried in mass by the current to the open sea. This is called *the shooting out of the ice-friths*, which lasts till late in the autumn, when the continual easterly storms finally clear out the inner waters, unless the icebergs are intercepted by certain banks, on which they sometimes remain long aground.

It has been said above, that those parts of the *inland* ice, which are thus moved strongly down to certain friths, and which we have called *ice-currents*, may be assumed as pointing out the directions of the old rivers which flowed through the country before it was entirely covered with ice, and before the valleys through which they ran were level, as they now are, with the tops of the mountains. As in milder climes, the water is carried away from the land in a fluid state through rivers; here it is gathered and carried away detachedly in the frozen condition of *ice-currents*. We are especially led to this consideration by the quantity of the animal production in such places, where we could expect to see mouths of rivers forming outlets to a large continent. It is certain that, in the interior of the ice, reservoirs of water are preserved throughout the year; in some places mighty springs are seen to come forth under its outer edge, pouring out *clayey water* in continued quantity throughout the winter; but it is probable that such masses of water discharge themselves through fissures of the continental ice, in those places where it moves quickest down towards the great ice-friths. This flowing water, in the interior of, and *under the ice*, may perhaps contribute towards explaining its motion over large tracts of land in the direction of the ice-friths. Icebergs consist mostly of hard, brittle ice, of which the white colour originates from very fine lineal pores, uniformly divided through the whole mass, all being of the same size, equidistant, and parallel throughout the whole iceberg. This uniform structure may have arisen at the time it was formed in the interior of the country from corned snow—perhaps repeatedly thawed and frozen. The white iceberg is in many directions crossed by broad stripes of intense blue-coloured ice, which is

quite clear, and either contains no air-bladders, or, at all events, very irregular ones. These blue stripes are several feet in dimension, and in them are generally found "dirt bands" of foreign matters, such as stone, gravel, and clay, which the ice-bergs carry off embodied in them. The *blue* ice is, by thawing, dissolved into regular large grains, which is not the case with the *white* ice that forms the main mass of the icebergs. It seems probable that these blue stripes are formed by a filling up of the fissures in the *inland* ice with water—perhaps mixed with snow, gravel, and stones; and such a refrigeration of the water in the fissures may be supposed to be an important agency in setting in motion these great mountains of ice.*

XI.—*On the Island of Ruad, North Syria.* By Capt. WILLIAM ALLEN, R.N., F.R.S., F.R.G.S.

Read June 14, 1852.

THE power and prosperity of Tyre probably owed its rise to the simple advantage of an island, lying near a fertile coast, devoid of harbours. It is one among the numerous instances of what has been accomplished by the unfettered energies of a maritime people. Similar circumstances on the shores of northern Syria led to the same results. A colony of exiles from Sidon emulated the glories of Tyre in the little island of Aradus, the modern Ruad. Destruction here has not been so complete as at Tyre,—enough remains to testify to the boldness of the race, and to shadow forth the grandeur of its prototype in the South.

Although probably never so powerful as Sidon and Tyre, Aradus shared with them the honour of founding Tripolis, and its prosperity may be inferred from the description of Strabo, who says it was "habitationibus plenum; tanta hominum multitudine ad hoc usque tempus, ut domus inhabitent multis fastigiis aptas."

I made a little survey of this island in the spring of the year 1851. It is situated in lat. 34° 49′ 20″ N., and long. 35° 51′ E.† There are two little ports, occupying the whole of the eastern side of the island, or that facing the continent, about 400 yards in length. This is the only shelter from the prevalent S.W. winds and heavy seas, that have the length of half the Mediterranean to rouse themselves in, before expending their fury on this open coast.

The ports are formed by three piers or moles, showing more or less their ancient construction, but especially that in the middle,

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* *See* Dr. Rink's late work, 'De Danske Handelsdistricter i Nordgrönland,' with map. Copenhagen.—ED.

† According to Mr. Hooper, Master of H.M.B. "Frolic."

which is nearly perfect, formed with blocks of sandstone 16 feet 6 inches long, and nearly 7 feet broad and deep, placed transversely. At the extremity of this pier are two stone bollards 8 ft. 8 in. in diameter. The whole length of the pier could not be ascertained, but the part projecting from the present water-line, measured for one little base, is 224 feet. The southern pier still also serves its purpose, but as it is occupied by a mosque, it could not be examined.

What remains of the North Mole is entirely ancient. In both ports, and continued round the middle pier, are traces of quays of concrete, now below the surface of the water, from which it may be inferred that a subsidence of the island has taken place at some period.

Stretching across the northern part of the island, from the base of the pier, is a fine bed of concrete, about 200 paces long by 150 broad, very nearly level, but declining towards the port, where its margin forms the quay. This concrete is continued round the west, in width about 35 paces, increasing very much towards the southern shore. The probable purpose of this was to gain space by an artificial increase of the size of the island, effected by levelling the summits of the rocks surrounding this part of it, the interstices being filled with the fragments, embedded in a concrete, as hard as the rock itself, which it perfectly resembles. In some places, instead of the fragments, are numerous small squared stones laid side by side in the concrete. The broad inclined plane was probably the arsenal, and where vessels were hauled up for better security during bad weather.

Along the three *outer* sides of the island are gigantic vestiges of the ancient walls, which in two places have, still standing, five or six courses of stones, measuring 15 and 18 feet in length, lying transversely, and forming the thickness of the wall. On the west side, the wall to the height of 8 or 10 feet is cut in the solid rock. On this side, only, to seaward the rocks have been cut so as to have the appearance of a moat and glacis, or outer wall, to break the force of the waves in the most exposed part. These could not easily be measured, but the moat is nearly 30 feet wide. There was no time for conjecture on the spot, but reflecting afterwards on this curious feature, and on the existence of a culvert, about a foot and a half wide, found in the concrete, leading from, and through the wall, with a slight declination towards the port, I conceived the idea that it might have been intended for the purpose of sluicing and cleansing it, as there is here hardly any tide.

The central and original part of the island is nearly covered by the modern town, which has wonderfully increased within the last century. Pococke, who was here in 1738, found "very few houses except in the castles." I found these occupied by a formidable garrison of the gentle sex, who resolutely opposed

my attempts at taking a round of angles, from the central tower. Fifty years after Pococke's visit, Volney says, "there does not remain a single wall, of that crowd of houses which, according to Strabo, were built with more stories than those of Rome itself." An old man told me there were but very few houses when he was a child, and he had heard that a hundred years ago there were only five; now he asserted there are about 500, which is an over estimate, but they are much crowded in one part of the town.

There is here an appearance of bustle, and it is evident that some portion of the energy of the ancient Aradians has descended to the present inhabitants, which may give them claim to be considered as their posterity. In support of this may be adduced the manifest propensity of the boys of Ruad, which is entirely nautical. They all amuse themselves with ship building. Their tiny vessels are very neatly made, rigged, painted, and pitched. Moreover they carry their mimic labours to a legitimate result, by always sailing their little argosies well freighted.

These early indications of a love of enterprise have their full development in the men, who are all sailors, or employed in ship building, which would be very profitable, if it were not for the absurd restrictions of the Turkish Government, which will only allow vessels of very limited tonnage to be built; and although five of large size, which I saw on the stocks, would prove that the law is either evaded or relaxed, it is most likely the result of bribery, and must be vexatious in any case.

Twenty-eight vessels, of small size, were lying in the south port, which appears to be more frequented on account of the greater number of houses near it, although the other is deeper and more secure.

As no part of the island is available for cultivation, supplies of provisions come from the mainland, about half a mile distant, which must have been the case with the ancient Aradians.

Water is at present obtained from cisterns under the houses, and some excavations would show that the same expedient was formerly adopted, though Strabo describes, very circumstantially, a submarine source of fresh water, "in the strait a little before the city;" with the ingenious method by which the islanders obtained it pure, in the midst of the salt water. The present race appear to be ignorant of this treasure.

The roads of Ruad will probably be found serviceable, as shelter for ships on this dangerous coast, as commerce is increasing, and it would be a very good station for a coal depôt. The position and soundings will be well known by the excellent survey made by Mr. Hooper, under the orders of Commander Vansittart, of H.M. Brig "Frolic."

XII.—*The Ancient Harbour of Seleucia, in Pieria.* By Captain William Allen, R.N., F.R.S., F.R.G.S.

Read June 14, 1852.

Syria, so remarkable for great internal resources, is equally noted, in the present day, for a dangerous coast devoid of good harbours. It was not so in ancient times, when industry and science overcame these disadvantages and provided many secure ports. The most magnificent instance of this, the Harbour of Seleucia, in Pieria, is in the Bay of Antioch, near the mouth of the Orontes, which owes its name, at least, to Sèleucus Nicator. This noble work* comprises a small outer port, an inland basin, and a stupendous culvert; which last was doubtless intended for the purpose of cleansing the one and feeding the other. The port is formed by two massive moles, projecting to seaward, about 240 paces apart. That to the N. can only be traced in ruins above the sand which has filled the port. The southern mole has its inner part nearly perfect, constructed with large blocks of stone placed transversely; and it must have been nearly 30 feet wide, as some of the stones measure 23 feet in length, and one which was broken was 29 feet 4 inches. It ran out W. from the shore 80 paces, and then turned to the N.W.; the latter portion is completely ruined, and can only be traced for a short distance under water. The whole area of this harbour, including a part towards the entrance of the canal, which was possibly excavated, would be about 6 or 8 acres, and was therefore small, though perhaps it answered sufficiently the purpose of receiving ships preparatory to their entering the basin, where the operations of loading and of unloading would have been carried on. It also served as a harbour of refuge in bad weather. It is now completely filled, from the bend of the pier, inwards, to the canal, the maximum thickness of the sand, &c., being about 18 feet, exclusive of the original depth of the harbour.

The basin, or inner port, seems to have been entirely an excavation. It is retort-shaped, and communicated with the sea port by the *neck* part, a canal about 1500 feet in length; but whether it was open to the sea in the outer port, or being there at a higher level was entered by a lock—if the ancients knew the use of such a contrivance—I am not able to determine.† At the entrance of this Boghaz or canal is an isolated rock, with a large chamber excavated in it.

* Colonel Chesney examined it during his excellent survey of the Orontes and the Euphrates, and I should not have put my observations forth but that I have some peculiar notions as to the most feasible way of restoring it.

† Col. Chesney saw hinges for gates.

The basin is about 2000 feet long by 1350 in the extreme breadth. The W. side of it is formed by a wall of large blocks of stone, and is nearly perfect in the whole length, except where it has been broken through in an ineffectual attempt to drain the basin. Near a tower projecting seaward, it is not less than 20 feet above the level of the water within the basin. The S. is principally formed by the "toe" of a little hill, which, on the S.E. part of the basin, has been levelled to the extent of about 500 feet square. On one side a noble wall still performs its office of supporting the hill. The space thus obtained was possibly the arsenal or dockyard; it has several ruined buildings. From this part the curve of the basin is bounded by a low wall, but whether ancient or modern, I could not get near enough to see: it is doubtless on the ancient site. The slope of the hill above it is much encumbered by the ruins of buildings, and stones, &c., brought down by torrents. All round the margin, except to the W., the basin is dry; but a great part is covered with water, varying in depth, being in some places, according to the accounts of peasants, 12 feet, though others said only 5 or 6. Long grass grows in it. The water comes close up to the W. wall, where some fallen stones seem to be lying on a quay; but, though clear, the water was dark, so that we could not see far below the surface. A small stream passing through the basin prevents its being altogether stagnant. It enters on the E., and has its exit by a gap in the W. wall, before mentioned; and, flowing gently towards the shore, about 1000 feet, loses itself in the sand above the level of the sea.

Taking into consideration the undisturbed appearance of the stones forming the south mole of the sea port, as well as those of this wall, and the depth in the basin, I cannot think that the land has been raised by any volcanic agency; the sand thrown up by the action of the waves during a long period would be sufficient to make the margin of the shore encroach upon the sea; while that carried by the wind would accumulate upon the land, as is evidenced by the bank of drift-sand against the wall of the basin.

The most remarkable feature connected with the port of Seleucia is the long culvert excavated in the adjacent hills. To examine this, we descended about the middle by a staircase cut in the rock, on its left side, near a little foot-bridge, which also appears to be a part of the rock. Exploring our way upwards, we came to an open valley, across which, just below a sharp turn in it, are the remains of an ancient wall or "bend" of massive dimensions.* This confined the mountain torrent to its original direction, and towards the excavation or culvert from which we had just emerged.

* Similar to the Bends at Belgrade, which dam up the water in valleys for the supply of Constantinople.

It is in good preservation at the two ends, but in the middle part there is a huge gap, where, in all probability, had been originally sluice gates, for the passage of the water requisite for feeding the basin. The dilapidation is attributed to the Turks, but neglect of the gates, and the large boulders brought down by the torrents, would be sufficient to account for it.

Returning to the "culvert," at 50 paces from the W. end of this great wall, the excavation commences with a tunnel, remarkably well cut in the rocky hill, 142 paces in length, with an aperture 21 feet square. In the middle is a channel about 3 or 4 feet in depth and breadth, and at the left side is a conduit, like a grooved shelf in the rock, which is carried nearly horizontally as far as the stairs by which we descended—406 paces. Here it meets the surface of the hill, and was doubtless continued thence to supply some part of the town with water. At the termination of the first tunnel is a fine "cutting" of 88 paces in length, open to the surface of the hill, the vertical section of which, at the upper end, is about 150 feet, declining, so that where the second tunnel commences, it is but 75 feet high. On the left of this cutting are the remains of a staircase in the rock, with the lower part broken away. The second tunnel is precisely the same as the first, but only 45 paces in length. After this, the open cutting is continued to the termination of the culvert. The vertical section of the upper part, that is, on leaving the second tunnel, is about 50 feet; and it declines gradually, varying with the undulations of the hill.

The two tunnels, *only*, have channels in the middle.

At the distance of 406 paces from the bend, is the little footbridge before mentioned—an arch spanning the cutting, about 20 feet deep, here. It is much worn in the middle by the many feet which have crossed it during more than 2000 years.

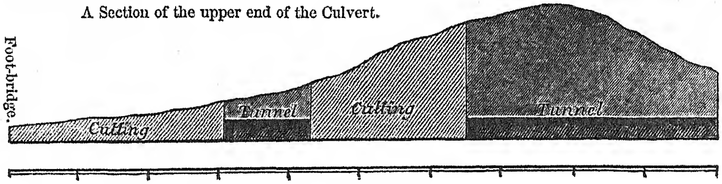
At 438 paces, a small lateral valley crosses the culvert; and here a wall on the left hand would be necessary, to preserve the course of the water, but it escaped my notice.

At about 750 paces the hill had declined so much, that for about 40 paces the left side was formed by a wall of squared stones, which was broken through some years ago in the hope that the torrent would clear the port; but it was mismanaged, and did great mischief by bringing down large stones and silt which completed the filling up of the Boghaz, and destroyed a great deal of valuable garden-ground.

The culvert, about 1200 paces from the bend, opens out and terminates near the north pier of the sea port, for the sluicing and cleansing of which, as I have said before, for feeding the basin by the gates, in the bend, and for carrying off the waste water, it was no doubt intended. Both of these purposes it might again be

made to serve. Its magnitude has astonished travellers, and has been thought greater than was requisite; but it must be considered, that in mountainous countries, and in such a climate, during the rainy season, a passing cloud might pour down torrents, bringing with them detritus from the mountains, that would soon choke the tunnels if space were not left to facilitate its removal. For this purpose the ledges were provided on either side of the channel, where men might stand to work. In the cuttings this was not necessary, as there is ample space above. It is true that, although neglected for so many ages, the culvert is nearly free from obstructions; but this may perhaps be attributed to the partial dilapidation of the bend, which has thus afforded a "safety-valve." The course of the culvert is more tortuous than I have laid it down on the plan; the fall is, perhaps, about 1 in 50 as far as the little foot-bridge, but below that much greater; and in several places it is very abrupt.

A Section of the upper end of the Culvert.



Scale of 1000 Feet.

There are several inscriptions on the sides of the culvert nearly illegible. The following fragments are all that could be copied:—

ΕΠΙΚΑΙΠΟϒ
ΓΤΙ////CΚΟϒ
ΕΚΑΤΟΝΤΑΡΧΟϒ
λΕΓΕωΝΟC
ΤΕΤΑΡΤ///L
ΟCΕΝΑΡΧΙΗ

MCPPAI//////////
////////NEX/////NIS
LEG////NEUC

At 925 paces is the third inscription, much defaced:—

IMCAESARITAEHO
HAL/////NOA/////////R
RIO////RAMI///////
//////////
////////////
//////////
NORICAVG

High up in the rock, two other inscriptions, in sunk tablets, near an arch left in the cutting, are quite illegible.

From what has been said it will appear—

1st. That the outer harbour is nearly filled with sand thrown up by the sea, being quite dry from the turning of the south pier, at the water line, to the inner part, where the thickness of the sand may be about 15 to 18 feet.

2nd. That though a great portion of this pier is nearly perfect, the outer part is useless.

3rd. That the northern pier is almost entirely destroyed.

4th. That the canal of communication, or Boghaz, is filled with silt and boulders in its whole length, the thickness of the detritus at the outer and narrower end being, perhaps, as much as 25 feet, but less near the basin.

5th. That the basin is partially filled with silt, and the W. wall of it, the only part of the circuit not bounded by rising ground, is partially dilapidated.

6th. That the great culvert is injured at the artificial walls only.

It is thus evident that in its present state this noble work is useless; but such is its solidity and intrinsic excellence, that I presume restoration would not be difficult; since, of the three main features, namely, the great culvert, the inland basin, and the sea port, the two first require but little labour to restore them, though they would still be unavailable without the third—a sea port for communication with the basin. This also might be easily accomplished, as there is great abundance of material at hand, the shore is gradual, the bottom good for pile-driving, and labour is very cheap.

I am not able to make a correct calculation of the cost for clearing out the old sea port, if it would be feasible, nor of constructing a new one; but by a rough estimation, on the assumption that the bottom of the basin originally corresponded with 3 fathoms in the sea port, there may be about two millions and a half of cubic yards of silt in the inland basin, which is about ten times as much as was found in Ramsgate Harbour at the latter end of the last century. To remove this, according to the rate of wages in the country, would cost about 33,000*l.**

But it is useless making vague calculations of what the mere manual labour would cost, when the object may be attained more speedily and more economically by simply converting the basin into a wet-dock above the level of the sea, with which it should communicate by locks. This could very easily be done by raising and strengthening the W. wall, the only part of the circuit not bounded by rising ground. The perennial stream now running through it being then stopped by a sluice-gate, in the present gap, would fill the basin to any depth required. It would then be

* I have since found that Col. Chesney estimated the expense at 31,000*l.*

necessary to clear the Boghaz or canal, only to the level of the bottom of the basin. The mere manual labour of digging and removing the detritus between the basin and the sea, a distance of 500 yards, might, perhaps, be done by 300 men in 150 days, at a cost of less than 1000*l.* But by making use of the appliances left by the ancients, it would be easy to enlist nature to do the greater part of the work, and thereby save a vast deal of time, labour, and expense.

This could be done by making temporary sluice-gates at the inner part of the encumbered canal, and when the basin is filled, by using its immense volume as backwater. If, at the same time, the dilapidations in the culvert were repaired, the force of the winter torrents might be brought in powerful aid, and the combined effect would soon clear or scour a channel to the sea. The principal expense would then be for locks and masonry.*

The restoration of such a port, larger than our East India export and import docks together, being about 47 acres, where so many ships might load and unload at the quays, would stimulate and draw to itself, as the best outlet, all the trade, not only of Syria and Mesopotamia, but of the western parts of Persia, which now, small in amount, is transported by camels over the difficult and dangerous pass of Beilan, to the unhealthy port of Iskanderùn or Alexandretta; whereas, a good road, without the impediments of mountains, might easily be made from Seleucia to Aleppo, and thence to the Euphrates, which noble river would again become what it appears to have been destined for—the means of communication between the regions of the east and of the west.

It is not unreasonable to suppose that if this were accomplished, the fine climate of the beautiful valley of the Orontes would attract settlers from England, as well as many Christians from all parts of Syria; while the native population of the northern bank of the river, who are nearly all Christians, and who, though industrious and well disposed, are poor and stationary on the soil, would have elasticity imparted to their present inert condition, by the example and stimulus of new ideas and new sources of prosperity. From these germs improved grades of society would spring, and thus in a short time a large town might arise to emulate the glories of ancient Seleucia.

The same elements of prosperity which called forth and rewarded the exertions of the former possessors, still exist in the

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* The method here proposed proved to be effectual in clearing Ramsgate Harbour, where, on experiment, it was found that three discharges from one sluice-gate of a small backwater, had such power that they cut a channel down to the chalk 6 feet in depth, 10 feet wide at the surface and 3 feet at the bottom, and 100 feet long. Masses of chalk of several cwt. were ploughed up, and the force of the stream was continued a distance of 200 or 300 feet beyond low-water mark.

inexhaustible fertility of these favoured regions. To these the cities of the Tetrapolis, viz., Antioch, Apamea, Laodicea, and Seleucia, with many others, owed their origin and rapid prosperity; and if it was worth while to construct such magnificent works for the convenience of *their* commerce, it surely ought to be worth the while of their successors—the present occupants—since the riches of the soil are still to be obtained by industry, to avail themselves of these noble legacies, and especially to restore the port of Seleucia, which would require so small a proportion of the labour and expense originally bestowed upon it.

The result would be very beneficial to the Turkish empire, by adding to the revenues of the Sultan, and by infusing vigour into the provinces which now languish through the efforts made for the prosperity of the capital.

To Great Britain, also, the advantages would be undeniable, in opening new channels for our commerce, and by facilitating the communication with her Majesty's eastern dominions.

XIII.—*An Attempt to account for numerous Appearances of sudden and violent Drainage on the Sides of the Basin of the Dead Sea.* By Captain W. ALLEN, R.N., F.R.S., F.R.G.S.

Read January 10, 1853.

THE Dead Sea, or Lake Asphaltites of the ancients, is now generally understood to have a depression, below the level of the Mediterranean Sea, of more than 1300 feet: yet, hitherto, no satisfactory account has been given of the cause of this phenomenon.

If I venture on the subject, it is simply to record impressions, forced on my mind by certain features that arrested attention in approaching its mysterious shores by the route of Jericho.

These were principally—

1st. Some indications of alluvial deposit on the mountain sides, a little below the supposed point of the level of the Mediterranean, most apparent on the opposite range of Belka.

2nd. A succession of sand cliffs on both banks of the river Jordan, of corresponding forms and appearance.

3rd. Several parallel lines of pebbles, about 50 feet in width, near the northern shore of the Dead Sea. These were the more remarkable because, for several miles, not a stone had been seen; and between the lines the soil was a soft alluvium. They have the appearance of raised beaches, and perfectly resemble the actual beach of the lake, which is formed principally of flat pebbles of bituminous shale, with fragments of Lydian stone. No other specimens of bitumen were seen.

4th. The precipitous mountains bordering the lake are rent with ravines, and their innumerable peaks have a tendency to group themselves into a succession of plateaux.

5th. On leaving the N.W. angle of the beach some remarkable hills were passed, capped with a horizontal stratum of sedimentary formation, and having steep, furrowed sides On ascending the mountain road these characteristics became gradually less distinct, and at length were to be detected in a general sense only.

Similar features have been noticed by other travellers—such as terraces and cliffs in the southern and northern Ghor, which both slope towards the Dead Sea.

Now, if these remains of sedimentary deposit should be admitted as so many evidences of successive falling of the surface of the Dead Sea, it is presumable that its original level may be traced by these gradations to a coincidence with that of the Gulf of Akabà, to which this basin may then have been joined.

On this supposition the Lake Asphaltites, in its original state, was the upper end of a very long and narrow arm of the Indian Ocean, extending from the base of Anti-Libanus nearly 2000 miles.

The bed of this fissure must have been undulating, and was divided into several basins by narrow straits. Of these, one at Akabà may have been closed, at some unknown period, either by a gradual upheaving of the land, or, in another manner, by the growth of coral, by deposits of sand and gravel thrown up by the sea, and by the sandstorms of the desert.

That the latter is not a gratuitous assumption will appear from the present condition of the strait Tiràhn; where two well-defined banks, possibly of coral, appear to be advancing from the opposite salient shores; and between these banks the opening is little more than half a mile wide, and of unknown depth.

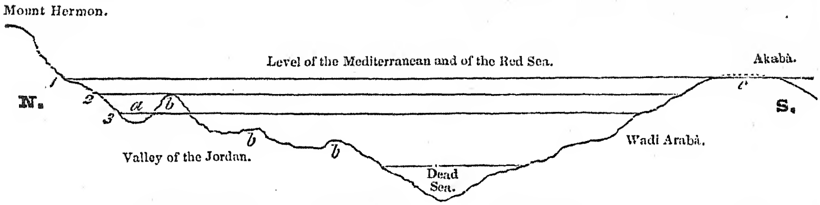
The action of similar causes may, therefore, have succeeded in converting the hypothetical strait at the upper end of the gulf of Akabà, into dry land; and communication being thus cut off, the surface of the basin of Asphaltites, being of greatly preponderating extent, as compared with the volume of water poured into it by the Jordan and other small perennial streams and winter torrents, evaporation from it would be in proportionate excess, and would speedily have caused its level to fall and its limits to contract.

The simple effect of evaporation would have left the whole drained bed of the basin with a covering of alluvium; but the interrupted lines of silt seen at different elevations, the terraces, the sand-cliffs, the parallel beaches, the flat-topped hills and the rugged ravines, would concur in showing that these levels were not always gentle and gradual in their subsidence, but that the

lake has been subject to occasional and sudden changes, of which these are the monumental records.

I proceed to show how this sudden drainage may have been the result of the modification of local circumstances.

For, granted that the basin cut off from the great fissure had also its undulations or irregularities in depth, then, since evaporation would have caused its surface to fall, let us suppose it to have fallen from the upper line in the diagram—representing the level of the Mediterranean—to the first undulation or barrier at *b*. The further process of evaporation would have caused a division of the waters at this point into two basins, of which the upper,



a. Lake Tiberias. *b. b. b.* Barrier. *c.* Dried Strait.
1. First line. 2. Second line. 3. Third line.

having the Jordan running through it, would, for the time, have preserved its level at the second line, while that of the other and larger basin would have continued to fall. Suppose it to have fallen to the third line, and then, by the weight of water in the upper basin, or by the action of the current of the Jordan, or by their combined effect, that the barrier should have been forced or cut through; the water of the upper would then have been transferred to the lower and larger basin, with a violence that would have torn and scoured its ancient bed, leaving traces of its former level round the margin, and marks of its action in ragged ravines.

But if the lower strata of the barrier had been of rock, hard enough to have resisted the action of the torrent, then a part of the water would have been retained in a depression, forming a fresh-water lake, as Tiberias, the sea of Chinnereth.

The process would have gone on, dividing the surface at the successive barriers; which also, having been forced, similar effects would have been produced by the violently retreating waters, leaving such vestiges as the monticules with their crowning attestations of a former level, the sand cliffs on the banks of the Jordan, and the more recently-formed parallel beaches, noticed on the N. shore of the Dead Sea.

As, however, none of the barriers have been hard enough to resist, except that at Tiberias, this is the only reservoir of fresh water that remains; and the Jordan winds its rapid course down the slope of the Ghor, to the last deep and central basin, the Dead

Sea; where the excessive saltness of the water will now be naturally accounted for, since it is a condensation of that which, having been a part of the ocean, was salt *ab origine.*

The process of evaporation and depression would still continue, till the surface of the Dead Sea should be reduced to such an area as would just balance the water discharged into it; and then, the only changes would be in the oscillations of that balance, caused by extraordinary floods or droughts.

From a fact observed by travellers in three consecutive years, namely, that a salient part of the N. shore is sometimes an island, and sometimes peninsular, there is some reason for conjecturing that the point of equilibrium has been already reached.

This might be ascertained by more careful observations at that locality, or by comparing fresh lines of soundings with those taken by Captain Lynch, U.S.N., in the southern portion of the sea: "The bay that looketh south."

XIV.—*On the Watershed of Wadi el Arabà.* By Captain William Allen, R.N., F.R.S., F.R.G.S.

Read February 14, 1853.

As the existence of the great depression of the Dead Sea, below the level of the Mediterranean, was unknown till the year 1837, so the fact of the downward slope of Wadi el Arabà, though the necessary consequence of such depression, was overlooked till the Comte de Bertou traversed its whole length in 1838. For so gradual does the inclination appear, that it was generally considered as a plain; and many geographers had even entertained the idea, that the river Jordan anciently discharged itself into the Gulf of Akabà by this valley.

The fallacy of this was first proved by that traveller; but the extent and elevation of the tract of land lying between the northern margin of the Gulf of Akabà and the point, at the same level in Wadi Arabà, where commences the downward slope to the Dead Sea, is a problem that still remains to be solved.

This tract of land contains the ridge that separates the torrents flowing northwards, on one side, to the Dead Sea, and southwards on the other, towards the Gulf of Akabà. It is the "watershed," or waterparting, of the Wadi Arabà.

As the notices that have been given by travellers on this important point of physical geography—though at first sight they appear to be conclusive—are conflicting among themselves, I have thought it desirable to lay them before the Society, in order that we may be able to estimate the amount of knowledge now existing, as far as I can collect, on the subject.

Burckhardt, in 1812, crossed the Wadi Arabà on his road to Egypt from Petra. He says, it is a continuation of the Ghor, which may be said to extend from the sources of the Jordan to the Red Sea. He descended into the valley, near the lateral Wadi Ghurundel, which comes from the eastern mountains of Edom. He calls it a *plain*, presenting a wide expanse of shifting sand, whose surface is broken by innumerable *low hills and undulations*. He left this plain by a gentle ascent of an hour and a half in the lateral Wadi Talh, which discharges itself into el Arabà from the western mountains.

Irby and Mangles, in 1818, saw little of the Ghor, except in crossing the N. end of it. They were told that the *plain* at the top of the cliffs, which bounded their view to the S., continues all the way to Mekka without interruption.

I merely mention these to show that it was considered to be a *plain*. The only specific information on the subject is derived from the journey of the Comte de Bertou, which was undertaken for the express purpose of ascertaining the nature of the Wadi Arabà; and it is a great misfortune to science, that his indefatigable exertions have only led to results depending on his judgment; as his barometer was broken long before he reached the point in question. Nevertheless, he gives it as his conviction, that the separation of the waters is at the embouchure of the Wadi Talh, 55 miles from the Dead Sea, and about 45 miles from the Gulf of Akabà; because—

1st. He says it is impossible to mistake the two slopes N. and S.

2nd. He thought the slope towards the Red Sea must be very rapid, because his horizon was very confined, and cut the cape, at the foot of which the castle of Akabà is situated.

3rd. On the authority of his Arabs, who gave the name of Wadi Akabà to the southern prolongation of the valley.

The opinions of this traveller are entitled to great respect, from the minuteness of his observations, from the care he took to keep in the trough of the valley, and from his evident anxiety to ascertain the truth; but as they are at variance with those of other travellers, it will be well to examine and compare them.

1. With respect to the unmistakable slope N. and S., I find that 4h. 10min. before he had arrived at this point, which he calls the watershed, he suspected the intention of his Arabs to mislead him; he therefore left the direction which they pointed out, to the eastward of S., and, depending on his own judgment and on his compass, he proceeded nearly S.S.W. or 220°; and thus in his anxiety to keep in the trough of the Wadi Arabà, it is possible that he may have entered that of Wadi Talh, a lateral valley; and, standing on the right bank of this, the point of separation between the two valleys, would necessarily have seen two

slopes. Now, although the Arabs are believed to have a systematic predilection for lies, they may in this instance have been telling the truth—namely, that the direction of the trough of the Wadi Arabà was more to the eastward than the course taken by the Count. This will hereafter receive confirmation, from an observation made by Dr. Robinson.

2. If I understand the remark about the horizon, at this point, being very confined, I should consider it to be the effect of a rise, rather than of a fall in the ground, since a rapid slope downwards would give an extended horizon.

3. By the name Akabà (ascent), given by the Arabs to the valley S. of the junction with the Talh, was probably meant the ascent of the road to Egypt by this Wadi, which took Burckhardt an hour and a half before he reached the summit of the mountains.

Lastly. De Bertou continuing his journey, at 7 miles from the supposed watershed, came to the lateral Wadi Ghurundel, which, coming from the mountains of Edom, is supposed and asserted by Robinson, on the authority of his Arabs, to discharge its waters northwards into the Dead Sea. Returning from Akabà, De Bertou kept on the *eastern* side of the Wadi Arabà; and at a place called El Sath (the roof), our traveller believes himself to be again at the culminating point, as the hills extend E. and W. It is opposite to Wadi Talh, but the breadth of the valley between these two positions is no less than 14 miles; therefore it is not improbable that at both he was at or near the extreme margin of the valley, which may be presumed to have a considerable depression towards the middle. The range of hills is no proof to the contrary, as the watercourse might lie between them. He gives the elevation of El Sath, above the Mediterranean, as 480 Paris feet; but only by estimation. His results, by the point of boiling water, must be very wide of the truth, as there is a great discrepancy between them at the two stations; and they differ very much from his estimation at El Sath. They do not appear in his paper in our Journal, but it must be remembered that he had only a common thermometer. I therefore submit, that notwithstanding the zeal and exertions of M. de Bertou, his data are not sufficient for determining the position and elevation of the watershed.

Dr. Schubert's barometrical observations have also been taken as determining this important point; but his words are not to that effect, and he makes several pertinent remarks which would lead to an opposite conclusion.

His road near the foot of the eastern mountains began, soon after leaving Akabà, gradually to ascend. The valley widened to about 12 miles, with a rapid slope from the E. towards the W.; and "while along the foot of the eastern heights one travels

on the edge of the valley (auf dem Firsten des Thales),—on its western margin, along the side of the Tyh mountains, one is in a depression, which, in the middle, is very little above the level of the sea, and must, in the rainy season, be overflowed in the greater part." He says this may account for the prolongation of the Ælanitic Gulf, towards the N., which appears in some of the old maps.

Another important remark of Dr. Schubert is, that the lateral valleys, from both the eastern and the western mountains, converge to the northwards; therefore the course of their united waters in the Wadi Arabà would be in that direction, and the watershed must be to the S. of the first point of convergence. It is true that this cannot be determined by a remark in such general terms, but the presumption is, that it must be far S. of the parallel of Mount Hor, and not far from the head of the gulf, since this is one of the first observations of our traveller after leaving Akabà. Now, the positions El Sath and the mouth of the Wadi Talh are very near the parallel of Mount Hor, which would confine the convergence, towards the N. of the lateral valleys, to the short distance of 55 miles from the Dead Sea; and as its distance from Akabà is 45 miles, if we assume the slope on either side of this ridge to be the same, there would be only 10 miles for the fall of the valley from the level of the gulf to that of the Dead Sea, 1312 feet. This is twice as great as the fall between the lakes Huleh and Tiberias, and does not agree with the accounts of travellers of a slope so gentle that it has the appearance of a plain.

At the distance of one day and a half from Akabà, Schubert's elevation above the sea, by barometric observation, was 465 Paris feet; on the third evening it was 954 feet; and as he does not say anything about the watershed, there is no more reason for taking the first than the second for its height; but the coincidence in position and elevation with De Bertou's hypothesis might have led to its adoption. It appears to me more likely that he had arrived at a high point of the Shera mountains, especially since he says the Arabs had selected this spot for their village of tents, on account of the abundance of pasturage for their flocks in the lateral and adjacent valleys.

Dr. Robinson crossed the Wadi Arabà at two places, but did not go through its whole length. He says the torrents from the Western mountains, when not absorbed by the sand, fall into the Gulf of Akabà, near its N.W. corner. There is no appearance of any other watercourse; but, on the contrary, along the rest of the northern shore the sea has thrown up an unbroken bank of sand and gravel higher than the level of the Wadi, which seems to have little or no acclivity to the N. Towards the Western

mountains a large tract has the appearance of moist marshy ground. The most important information given by this observant traveller, is the description of the Wadi, as seen from the pass of Nemela, a commanding position on the flank of Mount Hor. He says—

"Towards the S., the direction of a small fountain, 'Ain Melihy, was pointed out at the mouth of a short Wadi S. of the Jerâfeh. In the same quarter we could distinctly perceive Wadi el Jeib, (the trough of el Arabà) winding along the middle of el Arabà, from the south, and at length sweeping off N.W., as if to meet the Jerâfeh; and having received this Wadi, it again winds N.E. and afterwards north-westerly, so as to pass El Weibeh at the foot of the Western mountains. Here our guides again assured us, that the waters of the southern Wadi Ghurundel flow northwards through El Jeib; and we had no reason to distrust the accuracy of their information; for the whole appearance of the Arabà, and of the Jeib winding through it so far S. of the Jerâfeh, led naturally to the same conclusion."

Again he says—

"We had now learned enough of the region, to understand why the Jerâfeh and all the Wadis which drain the Western desert should run towards the North, a fact which at first appeared very singular."

Now, supposing the Wadis Talh and Jerâfeh to be identical, it is evident that the trough of the Arabà—the Wadi Jeib—has its origin far to the S. of the supposed watershed of De Bertou, and in its north-westerly bend to meet the Jerâfeh or Talh, there is presumptive evidence that his Arabs were right in wishing him to take a course to the S.E., so that by rejecting their advice he left the trough of the Arabà and entered that of el Talh. This will not appear strange, when we consider the difficulty there is in tracing a watercourse in the wide expanse of a sandy desert.

The salt-marsh seen by Rüppell and Robinson strengthens the hint thrown out by Schubert, that it may account for the prolongation of the Ælanitic Gulf in old charts, and would show analogy with the bitter lakes at the head of the Gulf of Suez. Both may have been detached from the Red Sea by the same upheaving; but, in any case, the existence of this salt-marsh is a proof that there is level ground to that distance at least, which must limit the length, as well as the height, of the upheaved tract,—the hypothetical strait that originally joined the basin of the Dead Sea with that of the Gulf of Akabà, to which I alluded in my former paper.

From a consideration of these circumstances, I therefore submit, that the extent and elevation of the watershed of Wadi el Arabà are still unknown. The subject is of great importance, both in itself and in the consequences to which it may lead. I venture to suggest that it behoves Great Britain to solve the problem, since the discovery of the depression of the Dead Sea

was made by two of our countrymen, Messrs. Moore and Beke, and verified by Major Symonds, R.E., and Lieut. Molyneux, R.N.,—followed up by the American government, which sent an expedition at considerable expense across the Atlantic to continue their surveys.

XV.—*Further Considerations on the Great Isthmus of Central America.* By Capt. Robert FitzRoy, R.N., &c.

Read March 14th, 1853.

In November, 1850, a Paper on the American Isthmus was read to the Royal Geographical Society, and was subsequently printed in their Journal, vol. xx., part ii., p. 161.

To that Paper it is proposed that this should be supplementary, because, although additional information has been obtained, nothing has yet appeared to invalidate the contents of that compilation; and it will save time to refer to those briefly, rather than incur the risk of unnecessary repetition.

Geographical investigations are, in themselves, so very interesting, that their possible importance in a rather unscientific though a practical point of view may be less present to the mind of a lover of truthful information (for its own sake) than to the keen eye of enterprise. But such comparative indifference to consequences may be valuable in examining a much disputed question, as tending to promote impartiality.

Interesting and important to the whole civilised world as the Central Isthmus of America has become during the present century, its interest and its importance have been augmented during the last few years in a manner that seems destined to engage a large share of public attention.

Becoming year by year a greater thoroughfare, more and more frequented by increasing numbers of the migratory and enterprising Anglo-Saxon race, by the carriers of mail-bags and merchandise, and by the bearers of gold, the formidable barrier that so narrow a neck of land still opposes to unbroken and direct commercial intercourse is more and more understood and realised.

Scarcely had Asa Whitney tried to divert attention from Central America to his startling project for traversing a Continent, when Australian gold demanded instant and definite attention to a more rapid and better mode of communicating with Australasia—since when increasing demand for rapid voyages, and continual improvements in shipping, have irresistibly encouraged the desire to cut through the Isthmus. A spirit of enterprise that India, China, Peru, and even California, scarcely stimulated, has been caused

by gold in Australia; and now we see keen interest generally taken in some of the various plans proposed. The interest of geographers in the subject is, therefore, increased by the conviction that their unprejudiced examinations may become immediately useful—a stimulus as satisfactory as beneficial.

In the former paper on this subject seven separate lines were reviewed—only one of which appeared to be available as the site of a large ship canal for all nations. Since that time (1850) much valuable additional information has been obtained, which, without at all impugning the evidence then collected, adds so much to some portions of it, that the mind can hardly resist conviction.

The names of Kellett, Barnett, Barnard, Childs, Seemann, Ridley, Mosquera, Cullen, and Gisborne are conspicuous among those who have lately collected really valuable information on the Isthmus, and have made it available to the public.

From a study of the materials afforded by these authorities—very carefully collated and compared with those previously accessible—we may be justified in repeating that there are seven distinct localities on the Great Isthmus between North and South America where a railroad, if not a canal, is practicable. These seven places are in—1, Mexico; 2, through Nicaragua; 3, across Costa Rica; 4, at Panamá; 5, from San Blas to Chepo; 6, across Darien; and 7, by the Atrato and Cupica.

Much as the nature of each of these lines may have been discussed, and trite as the subject may be to many persons, it seems here requisite to recapitulate briefly their principal peculiarities, before examining any one locality more closely, and to recall to mind some few general considerations.

It is now commonly admitted, that a good port at each end of either railway or canal, across the Isthmus, is indispensable. It is also understood and allowed that the more westerly line would (cæteris paribus) be comparatively more advantageous to local interests than to those of the whole world.*

Now taking the lines in geographical order—from W. to E.—we find—

1. That the Mexican line must be nearly 200 miles in length, surmounting an elevation of about 600 feet, and terminating in ports incapable of receiving large ships (ships drawing more than 16 feet of water). Local interests may be greatly benefited by a railroad there, but those of the world cannot be embraced, notwithstanding the elaborate survey of Colonel Barnard.†

2. Canals through Nicaragua will not admit large ships, because neither the seaports, nor those of the lake, nor the locks that will be necessary, if practicable, can be sufficiently spacious and deep,

* Refer to Map. † Refer to his work.

because there will not be water to fill them as frequently as will be necessary. The nature of those sea-coasts is against artificial harbours on a large scale. The locks absolutely necessary must be not less than 20 in number, and the length of canals, including canalised rivers, cannot be less than 100 miles.

To make such a river as the San Juan navigable may prove very much more difficult and expensive than to cut a canal. Any combination of railroad and canal would fail to remunerate, while a shorter and better means of transit could be found in another place. Shifting cargo from ship to boat, from boat to rail; thence again to water, in the lake; once more to rail, and then a third time to boat, would be tedious, damaging, and expensive. A continuous railroad would be preferable.

3. Across Costa Rica there are facilities for roads, between excellent ports—the distance being supposed to be 54 miles; the nearest direct being only 40. But as the summit level has not been instrumentally ascertained, it is yet premature to rely on the report of Mr. Norris, Civil Engineer, of Philadelphia, that a line has been found by him,* in which there is no place at a greater elevation above the sea than 160 feet; although the report is sent to us in a printed "Description of a Road across Central America," and is supported by the concurrent testimony of Dr. M'Dowall, of "David" (in Costa Rica, Chiriqui), April, 1852; Mr. J. Whiting, C.E., of David, dated November, 1851; and Mr. William Ridley, C.E., June 22, 1849; besides five responsible gentlemen resident in David.†

Nevertheless the locality is so very favourable; the country is so wonderfully rich, in external as well as internal produce; the sea-ports are so convenient; and the climate is (comparatively) so healthy, that a thorough survey of this line is most desirable. It is here, on the south side, that Gutta Percha is said to be found. Vegetable Ivory‡ is also here, as well as in Choco. Coal exists, in large quantity, on both sides of Costa Rica.

4. Near Panamá the land is said to rise too much to admit of any canal without locks, and access to such a water communication must be inconvenient for want of adequate harbourage.

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* Note, Dec. 1, 1851.

† But the *eye-survey* rests on Mr. Norris's *estimation*. This gentleman was engaged as a chief engineer for the preliminary surveys made by the Panamá Railroad Company. Dr. M'Dowall resides at David; Mr. Whiting likewise. Mr. Ridley writes from New York. These gentlemen speak highly of the *coal* on both sides of this part of the Isthmus, and two (Ridley and Whiting) mention the *gutta percha*. Mr. Norris says to his employers, the proprietors of a grant for this route—"I have pleasure in congratulating the proprietors upon holding a privilege far more valuable than either the 'Panamá,' the 'Nicaragua,' or the 'Tehuantepec.'"—"I have no hesitation in giving the preference" (over the Panamá route), "even at the same cost, to the Chiriqui."—*Philadelphia, Dec.* 1, 1851.

‡ Seemann.

A railroad is already in fair progress there—such progress as only "United States" men would have accomplished, in defiance of all obstacles—however, assisted by British capital. It extends nearly half-way across, and may be completed (with one line of rails) in two more years. Unquestionably this railway will be thronged when complete. Even now it is in constant work, as far as it extends (from Aspinwall in Limon or Navy Bay nearly to Gorgona), though there are many long miles of the most toilsome scrambling to go through between Cruces and Panamá, without any kind of alternative as to conveyance.

This railway will require continual renovation in such a climate, a great part being constructed on piles, in swamps, where wood decays rapidly. It may be anticipated that this end of the railway will need reconstruction before the other end and its water termination are completed.

5. The narrow part of the Isthmus between Mandingo or San Blas Bay and the mouth of Chepo river has not been at all explored. The aborigines hold jealous possession of the interior, and do not allow any stranger to cross their territory. They steadily, but civilly, repulse all attempts to view the interior of their narrow domain. As it is said the Indians used to drag their canoes across from river to river,* it seems probable that a summit level, comparatively low, may be found there; but however good may be the port of San Blas, there is no access to Chepo, where a shoal extends about three miles seaward—an obstacle to any harbourage for shipping.

We have thus glanced over the more obvious reasons why no great ship-canal without locks can be formed, with any prospect of advantage to the world generally, in the western or central parts of the great Isthmus, except perhaps in Chiriqui; and there remain only two localities to be considered, namely, the Isthmus of Darien and the river Atrato.

In the paper read before this Society in 1850 (to which reference has already been made), it was said that the "Cupica and Atrato route appears *now* to offer a reasonable prospect of encouragement to undertake the construction of a ship-canal;" and it was then remarked, that "of other *less explored* tracks, the most promising are those between the Gulf of Darien and San Miguel."

In supposing that the Atrato and Cupica line would be preferable for a canal on the largest scale, it was presumed that the bar of the Atrato would be avoided by a short side cutting; that the Atrato is navigable for the largest ships to near the Naipi;

* See Dampier and Wafer.

and that from such a place a canal might be cut, without locks, to Cupica, the Naipi being used, with other streams, only to feed the canal.

All the reasons for this opinion are detailed in the above mentioned paper: but it may be added here, that, in a letter to Sir Woodbine Parish * (dated Berlin, August 12, 1851), the Baron von Humboldt referred to his early and unaltered opinions about Cupica and the Naipi, and expressed his regret at witnessing the commencement of expensive undertakings on the Isthmus before those places, which were pointed out by him as early as the year 1810 as suitable for such works, had been accurately surveyed.

In passing, allusion should be made to a *recent* statement of a resident in New Granada that Cupica Bay is worthless, and that the ridge of land between it and the Naipi is 1900 feet above the sea—rendering any canal impracticable. As the internal evidence of this gentleman's letter † shows that he mistook the places, and did not examine them closely, if, indeed, he landed at all, this statement, or rather this *opinion*, can have no weight. Humboldt had a plan of Cupica by the well-known Bauza, and we now have that made recently by order of the Admiralty.‡

Since 1850 further attempts have been made to explore the narrowest part of the Isthmus of Darien, between the Gulf of San Miguel and Caledonian Harbour; and their results, although

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* "A Berlin, ce 12 Août, 1851.

"Malgré mon âge antédiluvien, j'ai conservé le courage de mes opinions. . . . Je désirerois bien que vous puissiez faire parvenir l'hommage de ma vive reconnaissance à M. le Capitaine Robert FitzRoy, pour la bienveillance qu'il m'a marquée dans son intéressant Mémoire—On the Great Isthmus of Central America —(Journ. of the R. Geog. Soc., vol. xx., part ii., p. 181), à l'égard de mes plus anciennes inspirations sur le port de Cupica et le Rio Napipi. Il croit que j'ai deviné juste. Peut-être le Capitaine FitzRoy auroit il aussi quelque plaisir à étudier le carte très détaillée (de toute la province de Choco) que j'ai publiée en 1827, dans l'Atlas géographique et physique de la grande édition de mon Voyage aux Régions Tropicales (planche 23). Il y trouverait un croquis de la côte de Cupica que je dois à l'habile géographe Espagnol Don Felipe Bauza. Il est triste de voir qu'on hasarde de grandes sommes d'argent, et commence à couper des canaux, avant d'avoir examiné et soumis à des mesures astronomiques et hypsométriques les autres points dont la localité a été désignée par moi dès l'année 1810. La vérité se fait jour avec lenteur.

"Agréez, je vous supplie, Monsieur le Chevalier, l'expression de ma haute considération.

"Votre dévoué et très obédient serviteur,

"Le Baron de Humboldt."

† Don Juan de Dios Ulloa, Quibdo, Sept. 6, 1852.

‡ Any one who wishes for more information respecting the Atrato and Cupica line may find the question examined in the twentieth volume of this Society's Journal, Part II., pp. 161–189.

but imperfect, are most important. To say the very least, there is no argument in favour of the Atrato and Cupica line which may not now be urged with greater force in advocating the superior advantages of a line across Darien, the character of that place being so nearly ascertained.

And here let a passing remark be permitted with reference to any possible competition of canals—that the greater opening must become the world's thoroughfare.

When formerly discussing this subject, a strong conviction remained on all our minds that Darien should be surveyed without delay. The illustrious Humboldt assuredly did not state that *he* was "thoroughly satisfied that the Isthmus of Darien is superior to any other portion of the entire neck for a canal" on insufficient grounds. No one can approach the extensive knowledge of Central America, and comprehensiveness of intellect, possessed by the great cosmographer; but as no human authority is *infallible*, let us proceed to examine critically the facts and arguments more *recently* laid before the public in favour of a Darien canal, without locks, for the largest ships in the world.

Some topographical details shall now be submitted which will ask for the special attention of critical geographers.

In tracing, or attempting to trace, the routes of recent travellers in Darien there is extraordinary difficulty, although the locality in question does not exceed a space of 40 miles by 30. Strange to say, the routes of the old bucaniers, of Dampier, Ringrose, Sharp, Wafer, and Davis, the inland journey of that remarkable man Paterson,* and of the Spanish officer Don Manuel Milla de Santa

* Paterson says, "In our passage from Caledonian Harbour, we have six leagues of very good way to a place called Swetee (Chueti?). From Swetee to Tubuganti we have between two and three leagues not so passable, by reason of the turnings and windings of the river. At Tubuganti there is ten feet of high water," &c.

Paterson visited the Indian Cacique, ten days' journey from Caledonian Harbour, with Capitan "Andreas" (probably at "Ponca"). See Wafer.

Bucaniers of America.—Voyage of Captain Sharp.—"We marched at first through a small skirt of a wood, and then over a bay almost a league in length. After that we went directly up a woody valley, where we saw here and there an old plantation, and had a very good road to march in. There we came to the side of a river, which in most places was dry, and built us houses, or rather huts, to lodge in. (Anachacuna?)

"The next day of our march we mounted a very steep hill, and on the other side, at the foot thereof, we rested on the bank of a river, which Captain Andreas told us did run into the South Sea, being the same river on which the town of Santa Maria was situated.

"Hence we continued our march until noon, and then ascended another mountain, extremely higher than the former. Here we ran much danger oftentimes, and in many places the mountain being so perpendicular and the path so narrow that but one man at a time could pass. We arrived by the dark of the same evening

Ella,* can be followed on the old Spanish maps, but not in our modern ones, even the best; while there are no data hitherto published that afford more than a guess at the tracks of modern explorers after leaving the sea-coast. Mr. Gisborne has compiled, or rather copied, the principal part of the map, on which he has shown, *in red*, those portions which he himself saw and was enabled to lay down. No surveyor who reads his Journal and Report can doubt that he has given eye-sketches, aided by compass bearings and estimated distances; but the estimation of a practised eye is not to be undervalued. Dr Cullen can be traced up the Tuyra to Yavisa, and up the Paya; also up the Savana, but no farther inland.

The state of our geographical knowledge of that exceedingly interesting region is the following:—

All examinations, all surveys, of the Great Isthmus were made by Spain alone, while she held the country (till the years 1821-31). Very good maps of much of the Spanish territory existed at that time: but they have been copied and recopied by all manner of hands; scales and bearings have been altered, not intentionally, but by mistake; names omitted or mis-spelled; and absolute longitudes applied erroneously. Thus good original work came to be so deteriorated by its transmutations as to be almost useless.

No surveys need be better than some of the Spanish works

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to the other side of the mountain, and lodged again by the same river, having marched that day, according to our reckoning, about 18 miles.

"The next morning we marched all along the river afore-mentioned, crossing it often, almost at every ½ mile—sometimes up to the knees, and at other times up to the middle, in a very swift current.

"At the distance of ½ a mile from this place lived the king or chief captain of these Indians. About 9 we continued our march along the banks of the river above mentioned.

"The next day about eighty men embarked in fourteen canoes to go down the river. At the distance of almost every stone's cast we were constrained to quit and get out of our boats, and hale them over either sands or rocks; at other times over trees that lay cross, and filled up the river, so that they hindered our navigation—yea, several times over the very points of land itself. That night we built ourselves huts to shelter in upon the river side, and rested our wearied limbs until next morning. This being come, we prosecuted our journey all day long with the same fatigue and toil as we had done the day before.

"The next day the difficulties of the way were intolerable. That night we rested in huts.

"The next day we continued our navigation down the river, and arrived at a beachy point of land, at which place another arm joined the same river. Here the Indians rendezvous.

"We departed thence early the next morning, the last day of our march. Unto the point above mentioned the Indians had hitherto guided our canoes with long poles or sticks, but now we made ourselves oars and paddles to row withal, and thereby make what speed we could. About midnight we arrived and landed at the distance of ½ a mile, more or less, from the town of Santa Maria.

"The river at Santa Maria is twice as broad as the Thames is at London, and floweth above threescore miles upwards, rising to the height of 2½ fathoms at the town itself."—*Bucaniers of America*, 1695, *Part IV. p.* 12 (*Sharp's Voyage*).

* March 13, 1788.

undertaken towards the end of the last and during the beginning of this century. Methods and instruments were used by Tofiño, Malaspina, Espinosa, Bauza, Córdova, and others, that were not adopted if known by French or English surveyors until afterwards. Triangulation without the compass, bases obtained by angular measurements of known objects,* and the most perfect style of plan-drawing, on true principles, were practised by Spaniards before this century commenced.

The south coast of the Great Isthmus and the interior of Darien were not explored and mapped sufficiently, because of the hostile Indians, and political reasons connected with the gold-mines in that district. There was also another source of error in that particular vicinity which has only recently been eliminated, namely, the great difference of longitudes, according to the maps, between places on opposite sides of the Isthmus which are really in the same meridian. This amounted to more than 30 miles along all the coast from Chiriqui to Darien with respect to the corresponding southern coast-line.

Thanks to the far-seeing and indefatigable Hydrographer to the Admiralty, Admiral Sir Francis Beaufort, the British surveys have included much of the coasts of Central America, and they are now placed in relatively correct positions on our latest maps. Having therefore exact coast-lines, or boundaries, we can avail ourselves more readily of much Spanish interior detail; but it is exceedingly difficult to get at the *original* works.

A very neatly engraved and *apparently* complete map of the Isthmus has been lately published at New Orleans by Dr. Autenreith, but in reality it is only a copy of Spanish documents and recent surveys made by England—it is not an original work. There are in this country at present more materials for a map of Darien than exist elsewhere. Bauza brought copies of all the Spanish-American documents to this country, with many original maps; but there is still a great extent, nearly all the interior of the Isthmus of Darien, unexamined by the eye of a surveyor.

In the last century (1780) a Spanish party of five engineers and surveyors, under Donoso, escorted by a large body of troops,† was stopped by the Indians in the Chucunaque river, and obliged to return without executing their orders to survey the region near Caledonian Harbour; and *this* was the *last* attempt by Spain, or by *any one*, to make a regular survey of the interior of that part of the Isthmus.

In the valuable collection of Mr. Arrowsmith are many Spanish

* Masthead angles were taken in Córdova's Voyage, 1785-6.
† Four hundred.

documents, among which one plan, dated 1774, shows all the Spanish establishments, military and religious, as well as mining, at that date, in Darien. Others show details of a previous century, and a few give the earliest settlements of the 16th century.

And here allow one word to be said of the injury to *truthful* geography caused by copying old materials without acknowledgment, or by adding imaginary topography without explanation. The map by Dr. Autenreith has much the appearance of an exact survey; there is no distinction made between those parts for which there is authority, and those which are partly the results of imagination (the interior hill work).

The public in general being unaware of the *authorities* for a map, the mere copyist is often supposed to be the *author* of the work. Maps or charts that are not original ought always to show from what data they have been compiled.

In order to assist in now forming a correct opinion of Darien, a retrospective historical glance at a few points is necessary.

The first settlement in all America was founded in 1509 at the mouth of the Atrato. It was called Santa Maria el Antigua. The next settlement on the Isthmus was at Acla, or Agla, in 1514, a few miles inland * from that port or bay now famed in history and romance, called by Paterson Caledonian Harbour. It was from Agla that Balboa crossed to the South Sea, and that the earliest expeditions to Peru were despatched.

In 1532 these two settlements were abandoned, and their population transferred to Nombre de Dios and Panamá. This is said to have been done on account of the unhealthy site of Santa Maria el Antigua, surrounded by marshes and mangrove jungles; but why Agla was abandoned does not appear, except by Paterson's narrative, whence it may be inferred that the settlers there were harassed by the Indians, and were too far from the sea shore. Besides which, as intercourse increased with places on the Pacific coasts, it became, no doubt, more convenient to have a principal rendezvous on the southern shore, more accessible from the Pacific.

In those early days so famed was Darien for gold, that the province was called "Golden Castile"† (Castilla de Oro). It was the principal portion of that "Tierra Firme," so famed afterwards as the "Spanish Main," the real "El Dorado" to which Sir Walter Raleigh went in 1517-8, Sir Francis Drake in 1557, troops of Bucaniers in the seventeenth century, and the Scotch Colony in 1698.

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* Five leagues from the shore.—Sp. MS.

† The arms of Santa Maria el Antigua were a *golden castle* between a jaguar and a puma.

Repeated aggressions on this auriferous district, where abundance of gold was procured by black slave labour, after the aborigines had been diminished in numbers by oppressive cruelties, induced Spain to close and abandon the mines for a time (early in the eighteenth century)—even those famous ones in the mountains of Espíritu Santo, near Cana, from which alone more gold went through Panamá in a year than from all the other mines of America taken together. These Cana mines were sacked in 1702 and 1712 by English, in 1724 by French, and by the Indians in 1727. Nevertheless in 1774 the mining operations were again going on, having been re-established a few years previously.

When Cana was taken by the expedition (as narrated by Davis) sent from Jamaica, by Colonel Beckford, in 1702, there were about "900 houses" (probably most of them mere huts): therefore the population could hardly have been less than 3000 at that time. From 1719 to 1727 there was a great and general resistance of the Indians, who attacked the Spaniards in all directions, and drove them out of all the detached settlements. Some years afterwards peace was made (in 1740), missions of the Jesuits advanced among the natives, and by their aid not only much topographical knowledge was acquired, but Spanish settlements in the interior were renewed and mines worked.* But the Indians again rebelled: therefore small forts were re-established at Yavisa, Molineca, and Santa Maria Real; with a new post (in 1780) at *El Principe*, or Ocubti, from which a road was cut by Arisa, leading towards Caledonian Harbour. The fort "El Principe" does not appear in the Spanish MS. map of 1774: it was built about 1785, when the Spaniards had again advanced into the interior Indian territory.

In 1788, Milla de Santa Ella, an officer of Spain, went from Caledonian Harbour to El Principe direct by the road then recently opened by the Spaniards; but as he did not think it advisable to return the same way, he went down the Savana, and up the Chucunaque to the Tubuganti and Chueti rivers, whence he crossed to his station at Caledonian Harbour by the same route, undoubtedly, that Paterson traversed on his visit to the Indian great Chief at Ponca, in 1698.†

* The Jesuits were expelled in 1767.

† 1788, *March.*—"Sunday, the 2nd of the present month, I left Carolina at 6 A.M., accompanied by the Indian Suspani, captain of the village of Sucubti, and two of his comrades, with the linguist, commencing the journey by following up the waters of the Aglatomate, with many and repeated crossings, until we arrived close to the Cordillera, where the Indians of Chueti have a small house that serves as a hostelry to the above-mentioned Indians and those of Sucubti, who are the usual traders to Carolina by this road. From Carolina to this place the distance is 2½ leagues, little more or less. Upon arriving at a place they call the Two Mouths, it is necessary to follow that on the right hand, which in the dry season is quite dried up; and the better to know the place, one will meet an Indian shed covered

In 1790, a treaty of peace was concluded between the aborigines and the Spaniards in Darien, at which time the garrisons were withdrawn from Caledonian Harbour, Principe, and other places;

with plantain leaves, and at a little distance from this, in the line of the Cordillera, will be seen a smaller hill (elevation?) than those (that?) to the right. Up to this there will be found water in this branch of the river, which has in some places a bottom of sand, and in others of shells, whilst higher up there are stones and pebbles. Taking care, after recognising these marks, to keep to the right of the river, the path or trail leading to the above-mentioned hostelry, which is from 16 to 20 yards from the river, will be found: from thence the road over the Cordillera, from N. and S., cannot be missed, since, after crossing three or four small rivulets, or rather crossing the same one three or four times, with a little care a broken bank will be found on the right hand. This is where the path over the Cordillera commences, and it is as wide and trodden as if it were made by our people (Spaniards). The whole ascent is rather steep, and half-way up a fallen trunk of a tree stops the path. From this place may be seen the sea (Pacific?) and Carolina.

"Following the path to the right, and avoiding that on the left, which leads to Chueti, the mountain is crossed, the descent of which on the other side is more gradual and sloping. At its foot the River Forti (Morti or Moreti?) unites with the Sucubti. Following the Sucubti down to the S., after two or three hours of a good road, a plantain ground and a very small hut will be found; in half an hour another, both on the right hand; and in another hour a third, on the left hand side. ¼ league lower down, on the left hand, will be met another, larger than the rest. In this house I stopped to rest, having arrived about two o'clock (P.M.), and, after resting awhile, I proceeded by a road which is at the back of it; and ascending a mountain, the path over which cannot be missed, it is so beaten, I descended again to the river, which has here many rocks.

"Taking care not to lose sight of the river, there will be seen, first, an Indian hut, then another, and then the village of Sucubti. This village consists of six houses together—those above mentioned—and two or three lower down. It may have about thirty Indians capable of bearing arms, a few more women, and sixty children.

"*Monday*, 3rd.—I stopped at this village all day.

"*Tuesday*, 4th.—I started at daybreak, accompanied by the captain and two of his Indians, and followed down the river over level ground, and through an open forest; and about 10 A.M., after having proceeded about 2 leagues, we left the river altogether, following a path to the left. All the rest of this day we walked through a forest exceedingly level and open; here the Indians of Sucubti hunt, on account of the abundance of all kinds of game. At about 5½ P.M. we halted at a rivulet, which had scarcely water enough to satisfy our thirst.

"*Wednesday*, 5th.—We pursued our journey through the same forest, and at 10 o'clock we again fell in with the Sucubti. As soon as we arrived at this place, the chief told me that we could not proceed till some Indians should come with their canoes, to carry us down a short distance to the road that the Spaniards had opened (Arisa's road).

"*Thursday*, 6th.—Four canoes arrived with eight Indians, who, as I understood, were allied with the rebel Chucunas; and I found they were not of those who had entered into the peace with us, but were always watching to attack any of our people who might stray into the bush from the establishment of Port Principe. At 10 A.M. we embarked on the river, and about 2 leagues lower down we halted at the road that they call Arisa's.

"*Friday*, 7th.—At daybreak we proceeded along the road opened by the Spaniards, and after 3 hours' walk we crossed the Chucuna River by a bridge, and arrived at the island where Don Luis de la Carrera was (lately) emcamped. Here we found tracks and recently-erected sheds of the Chucunas, whereat (the chief) became alarmed; and to conduct me the more safely, he went before with the other Indians, I following a good distance behind until we passed the other branch of this river, lately named La Paz.

"About

Yavisa then becoming the seat of local authority, as it has since remained. From the time Spain lost her American dominions, New Granada has included Darien; but the Aborigines have held their ground on the Isthmus. No mines have been regularly worked. A few gold-washers only have frequented the rivers in the dry season. The very sites of villagės, and the actual localities of mines, have been overgrown by the thick underwood of tropical vegetation, and, except by tradition among the Indians, their places are forgotten.

So much has been published lately about the unfortunate Scotch Colony, that, however interesting the subject may be, only one or two remarks shall be here made in passing.

Paterson, its originator and founder, had himself visited the West Indies, was personally acquainted with some of the Bucaniers, and had gathered a great deal of information, especially from Wafer. He had acquired ample local information before he undertook his great enterprise. His was no wild or vague speculation, though unsuccessful. It was the creation of the same mind, of the same original genius, that planned and founded the Bank of England. But his Darien enterprise had inherent and radical defects, which chiefly caused its ruin. He invaded a country claimed by Spain, then at peace with England; he had no commission from his Sovereign to act hostilely; and there was no settled organisation with respect to conduct and discipline among the colonists. Whatever harsh orders or cruel disappointment took effect, it was not to the jealousy of the East India Company,

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"About 5 in the evening I had the felicity to arrive at Puerto Principe, where the said chief (Suspani) advised that we should return by the river Savanas, Chucunaqua, and Subganti, coming out at the village of Chueti, a short day's distance from Carolina, which plan appeared the best to Don Andres de Arisa, Commandant, who considered it attentively.

"10*th*.—I proceeded on my return back by the route above mentioned, and was two days on my way to Yavisa, as we only went when the tide permitted. (Chucunas Indians having followed their tracks, Suspani alone went forward to the mouth of the Subganti, and thence to Carolina, with the dispatches. Milla returned to Principe, and thence by way of Panama to his station at Carolina.)"—*Cullen's Isthmus of Darien*, 2nd edition, 1853, pp. 193-7.

In a diary signed by Antonio Velasquez, at San Fernando de Carolina, mention is made (Dec. 30, 1787) of the Indians of the Chuquanaqua being still rebellious, though willing to enter into the peace; from which it may be *inferred* that they and the Chucunas Indians above mentioned by Milla were the same tribe, and that the river Chucuna is the Chucunaque.

The route proposed by Arisa, from information given to him by Suspani, and the same by which Suspani guided Milla, was to ascend the Aglatomate one hour; then to ascend the ravine of the Cordilleras to the head waters of the Sucubti, an eight hours' journey; then to go down to the Chuquanaqua, half a day by water and one day by land, and turning to the right for six hours, over ground quite level, to reach Principe.—*Cullen's Darien*, 2nd edition, 1853, p. 49, 50.

alone, that the Scotch Company should have attributed their failure and extraordinary disasters.

It is remarkable that, although the first and second expeditions of the Scotch to Darien failed miserably, there was still so strong a desire to persevere, even among those who had suffered very severely, including Paterson himself, that a third enterprise was undertaken (by the gallant Campbell, of Finab), which was subsequently expelled by an overpowering Spanish force that invested the place by sea and land. The squadron came from Cartagena; but the land forces from Panamá, *across the Isthmus.*

A halo has lately shone around the Scotch enterprise, in consequence of the interest excited by the work of the justly lamented Eliot Warburton, called "Darien." So keenly had that author himself entered into the subject, that he was actually about to explore the mysterious barrier personally, when lost in the Amazon, mail steam-ship.

The examination of no traveller, except Humboldt, previous to 1850, induced a belief that a canal might be cut directly through Darien. Dr. Cullen's personal inspection of Caledonian Harbour, and of the Savana river, with their neighbourhood, added to the information he obtained orally and by reading, led him to the conclusion, that the lowest summit level between those places did not exceed 300 or 400 feet, while it might be very much less. Feeling so confident that a lower level existed, he went there again to explore; but while collecting further information and arranging preliminaries, at Bogotá, the seat of Government in New Granada, Mr. Gisborne (an engineer employed by Messrs. Fox and Henderson) made short excursions from each side of the Isthmus, which satisfied him that the lowest summit level does not exceed 160 feet above the sea.

According to the most authentic map of this district, Mr. Arrowsmith's last printed, not yet published, the distance across in a direct line—between deep water on each side—is about 33 miles. The windings of a canal may require nearly a third more, and, if so, the whole distance to be canalised is about 40 miles; *a shorter distance than can be found elsewhere.*

It is to be regretted that Dr. Cullen has not yet published any sketch of *his* tracks across the Isthmus of Darien. He stated, in a letter to the 'Times' (of February 16, 1853), dated February 14,

"Not satisfied with crossing the Isthmus once only in 1849, I returned again from the Atlantic to the Pacific, having cut a *picadura*, or track, for myself, through the bush, from Port Escocés to the river Savana, which I navigated always, except on one occasion, alone; paddling myself in a small

canoe. In 1850 I again crossed and recrossed this part of the Isthmus; and again, in August and September, 1851, I, at different times, and in different lines, crossed from the Savana river to the sea-beach on the Atlantic."

Of such repeated explorations in so interesting a district, we have not yet been favoured with the details and itineraries. In trying to trace some of these journeys, we are stopped by perplexing doubts. But we owe Dr. Cullen much for valuable information gleaned from archives, maps, books, oral accounts, and his own personal observation. He was certainly the originator of the statement in 1850, that between Caledonian Harbour and the Gulf of San Miguel, a comparatively low summit level exists. We owe him too much for these important benefits to criticise unnecessarily. Not only has Dr. Cullen's statement been corroborated by Mr. Gisborne, but a much lower summit level is said to have been discovered, one not exceeding 160 feet, while it seems probable that point is not the lowest.

Mr. Gisborne's examination of the principal features of this line across Darien, however incomplete, is a material advance towards certainty. We have his two bases of operations, at Caledonian Harbour and San Miguel (entrance), nearly determined by recent Government surveys, and we have his character as a guarantee for the value of those details which he has given in his "Report." There may be a few miles of distance to settle, and there may be doubts whether the river near his watershed, or summit level, called by him *Caledonia*, may not be another river, perhaps the Chucunaque, or one of its tributaries; and, moreover, that the range of heights supposed by him to separate those rivers is not truly placed, while his river Caledonia (otherwise the Golden river, or Aglatomate) winds through a more northerly area. But these are trifles compared with his barometric measurement of the summit level, and his own overlapping eye views of the country which he did not traverse.

If indeed the mouth of the Savana be not accurately laid down, or assumed by him; if it be much farther west than he supposed, his surveys may not have overlapped; and he may have looked across two different plains; in which case there may be yet another ridge or watershed between the rivers which he actually touched. The expedition employed by our Government to survey this coast did not examine the mouths of rivers running into San Miguel. Only the western part of that gulf was examined, in continuing the coast line. Hence the position of the Savana may be less accurately known than is generally supposed.

It is hardly necessary to remark here that to make independent observations for latitude, longitude, distance, and accurate

triangulation, requires more time and instruments than can be carried in a hasty scramble through a wild country.*

Mr. Gisborne's examination of the geology and mineralogy is valuable. Far from discovering any remarkable impediments to cutting a canal, he states that there are *no* particular engineering difficulties with respect to the *ground*, that there is much stratified shale-rock, easy to quarry, and fit to line a canal. There is abundance of fine timber. Mangrove forests, rather than jungles, surround the waters of the gulf. Densely matted underwood follows on drier ground; and then, on the elevated country, there are magnificent timber-trees very little encumbered by underwood.

Having thus endeavoured to take a general view of this question, we may perhaps ask ourselves what are the greatest impediments to the excavation of a canal—impediments exceeding those that would attend any corresponding work in Europe?

Supposing that political arrangements are satisfactorily completed, the claims of other parties compromised or barred, and adequate funds disposable, the only peculiar and important impediments will be two—the natives and the climate. The native or Indian question, as connected with the independence and rights of the aborigines, should be considered deliberately. That the Indians may be overawed and conciliated by proper management there is no doubt; but their reasonable claims must be satisfied, irrespective of all jurisdiction assumed over them by New Granada—a jurisdiction which the natives of Darien repudiate. Fair dealing, while an overpowering force is in sight, will prevent any attempt to have recourse to arms, or to molest the parties employed about a canal, and would therefore obviate any irritating and probably prolonged guerrilla hostilities.

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* "Hydrographical surveys are always tedious and laborious, but they are peculiarly so on a coast like that of New Granada, where heavy showers of rain are followed by the sudden appearance of the sun, and noxious vapours which such exchange produces; where muddy mangrove swamps, swarming with alligators and generating unhealthy miasmata, line the shores for miles together; where in some places musquitoes are so numerous, that the surveyor requires more than human patience to endure the stings to which he is subjected; and where the nights are so hot and oppressive, that sleep is sought in vain.

"A chart may seem to be very simple to those who are not aware of the skill, diligence, and expense required to complete it; but those who have watched its progress, and the amount of labour required to finish even a small piece of such a delineation, look upon it with different eyes, and are able to appreciate the vast treasures which the Hydrographical Office, by its publications, is constantly offering to the public.

"We carried on our surveying operations along the coast of Panama and Darien until the rains, towards the end of April, began to be so incessant, that we were compelled to discontinue our task, and go back to Panama."—*Seemann*, vol. i. p. 139.

It is estimated that there are about 5000 independent Indians on the Isthmus E. of Costa Rica. Of these it may be presumed that there are not 2000 capable of bearing arms; a small number when dispersed in the highlands between Costa Rica and Choco, but quite enough to molest small parties of workmen very seriously.

For defensive purposes, as well as for the general order and discipline of very large bodies of labourers, in a wild country, some degree of military organization and an acquiescence in military discipline would seem to be indispensable.

Whether convicts might be employed advantageously may be a subject for grave consideration. In clearing the wood of a tropical forest, and exposing ground to the sun's rays for the first time, much pestilential sickness may be caused, as has been repeatedly proved (at Pulo Penang, Fernando Po, and many other places). It cannot be doubted that convicts would be peculiarly liable to the influence of such diseases, and therefore it might be unwise to make such an experiment. Natives of tropical climates, or Chinese, would probably be able to stand the malaria of newly-cleared ground far better than Europeans.

The most formidable, because permanent and irremediable, obstacle is unquestionably the climate. There is no doubt that rain prevails about two-thirds of the year even on the higher grounds of Darien, while it is no less certain that in the Gulf of San Miguel (where mangrove jungles bound low muddy shores, and the great fall of tide exposes extensive mud banks) there is a continued succession of rains, more or less heavy, except during short intervals. Examine any travellers' accounts, read their narratives—they themselves bear witness to the undeniable fact, although in *general* terms they may say there is not *so much* rain, and it is not *so* unhealthy as has been supposed.

Many Europeans state they did not suffer, although much and continuously exposed to the rains and heat. Active and temperate men have not found the climate very detrimental. Persons who have had many years' experience there assert that care and regularity will ward off such attacks of fever or dysentery as are common among thoughtless Europeans unaccustomed to tropical regions.

It is possible that the great rise of tide on the S. side of the isthmus may tend to purify the air on its shores, and this effect, in such a place as San Miguel Gulf, may be very beneficial.

On the Atrato—at Chagres—at Portobello—and other notoriously unhealthy places, there is little or no rise of tide; and the air among the mangrove jungles becomes at times pestilential. Seemann, in his 'Voyage of the Herald,' recently published,

gives so correct a description of such places, that it deserves attention. He says (vol. i. p. 249),—

"The sea-coast, and those parts influenced by the tides and the immediate evaporation of the sea, produce a quite peculiar vegetation, which is generally characterised by a leathery, glossy foliage, and leaves with entire margins. In all muddy places, down to the verge of the ocean, are impenetrable thickets formed of mangroves, which exhale putrid miasmata and spread sickness over the adjacent districts. Occasionally extensive tracts are covered with the 'Guagara de puerco,' its fronds being as much as 10 feet high. Myriads of musquitoes and sandflies fill the air. Huge alligators sun themselves on the slimy banks, lying motionless, blinking with their great eyes, and jumping into the water directly any one approaches. To destroy these dreaded swamps is almost impossible."

Again (p. 251, 252) he says,—

"Forests cover at least two-thirds of the whole territory. The high trees, the dense foliage, and the numerous climbing plants, almost shut out the rays of the sun, causing a gloom which is the more insupportable as all other objects are hidden from view. Rain is so frequent, and the moisture so great, that the burning of these forests is impossible." "From reading the highly coloured accounts with which many travellers have endeavoured to embellish their narratives, the European has drawn, in imagination, a picture of equinoctial countries which a comparison with nature at once demolishes."

Speaking of the "vegetable ivory," and referring to the climate, Mr. Seemann says (p. 222),—

"It grows in low, damp localities, and is diffused over the southern parts of Darien and the vicinity of Portobello, districts which are almost throughout the year deluged by torrents of rain, or enveloped in the thick vapour that constantly arises from the humidity of the soil and the rankness of the vegetation."

Describing the appearance of one of these mangrove forests, as they may be called, the same author observes (p. 73):—

"The trees were actually in the water. The tall mangroves, with roots exposed for 12 or 14 feet, formed a huge tangled trelliswork, from which the tall stems rose to a height of 60 or 70 feet."

Much may be done towards the preservation of health, as well as personal comfort, in such regions, by erecting extensive temporary sheds—on a wide scale—over places where work of any kind is going on. Materials for such sheltering roofs are abundant, and to be had for the cutting.

The effects of such a climate must, of course, increase the expense and diminish the durability of all engineering works. The process of "unwatering," as well as excavating, must be impeded to an extent that engineers in England can hardly realise in their estimation, unless they have witnessed a tropical rainy season, with its effects upon man and his operations.

By apportioning work according to the seasons, and keeping men regularly but cautiously employed, under shelter from rain or sun as much as possible, the difficulties attendant on the nature

of the climate may doubtless be overcome considerably. Any amount of shelter from rain, and any number of fires, can be easily provided in a country where wood is a positive encumbrance —absolutely a nuisance.

By clearing and burning, the climate may be improved, insects and noxious creatures scared away or destroyed, and the surface of the ground prepared for beneficial cultivation. But the fact must not be lost sight of, that the first exposure of ground to the sun in low latitudes has often been attended with the generation of fatally pestiferous malaria.

Great works *have* been effected on the Isthmus in times past; there are more powerful means of execution *now*. From the "*Desague*" and the *Pyramids* we may turn to the Panama Railroad, and reflect that the resources of the world are at the command of British capital.

In concluding this sketch, already too long for the allotted time, but too brief and imperfect to do justice to the important question of which it is a mere outline—only a few more remarks, even of a general character, can be permitted.

In deciding on the dimensions of a ship-canal, it will be necessary to allow width for the passage of the largest ships in opposite directions, and depth enough to ensure their floating at all times, even when some amount of detritus may have been swept into the cutting and there temporarily accumulated. Such dimensions should not be much less than 200 feet wide, and 30 feet deep, at the northern entrance, nor than 300 feet in width, and 50 feet in depth, at the southern termination.

Mr. Gisborne's estimates (pp. 28, 29; Journal, p. 231, Report) refer to a somewhat different hypothesis, one that seems not strictly reconcilable with the case; and the engravings of his sections in the *first plan* have not perhaps been corrected by himself, as they show the tide-levels somewhat incorrectly, on the Atlantic side. The supposition above referred to as described by Mr. Gisborne, is that the canal will have a horizontal bottom, and that there will be about 11 feet greater depth at one end than at the other. Now it appears certain, that if a canal, every where 30 feet deep at low water, open at one end into a sea where there is very little variation in the level, and at the other into an ocean which rises and falls about 20 feet, the mean level of both seas being nearly the same, there must be a depth of 50 feet from high-water-mark to the bottom at one end, and 30 feet at the other; the bottom of the canal being not horizontal, as Mr. Gisborne supposed, but

having a gradient, or gradual slope or rise of about 10 feet in the length of the canal. This will materially affect the estimates.

The peculiarity of the tides would somewhat resemble that of the Narrows, in the east entrance of the Strait of Magellan, where the tides of the Atlantic encounter those of the Pacific Ocean in a very remarkable manner, making high water or full sea at one and the same time (nearly), yet rising and falling 7 fathoms on the one side, and only 1 fathom on the other. Of course rapid streams are caused each way—very useful to navigators.

However theoretically true may be the mathematical results obtained by Mr. Gisborne, aided by Professor Stokes, from the data assumed, it may be premature to rely on any calculated degree of velocity in the current caused by tidal action through such a canal; because the windings cannot yet be determined, nor the length of the canal, on which will depend the amount of friction, and the consequent retardation of the movement of water from one direction towards the other. It does not appear improbable, that when once a free passage is opened from sea to sea, the tidal action will cause a more rapid current, and therefore a greater scour, than is anticipated. Such an effect would be highly beneficial, provided that the bars, certain to be caused near the entrances, be duly foreseen and guarded against, or cleared away, as they grow.

A peculiar *advantage* connected with the Gulf of San Miguel deserves notice.

There is no port in the Central or Southern Pacific Ocean in which docks for large ships could be constructed with less difficulty, except from climate, than in that particular locality. Great rise of tide, spacious harbourage, abundance of timber and stone, cheap provisions, and any number of American, or Chinese, labourers are the special facilities. It should be considered that there is no frequented port in the Pacific Ocean, between the tropics, or in the Great South Sea, where the tide rises sufficiently in a good harbour to admit of the construction of a large dry dock (without the aid of expensive steam engines), and that there is actually no dock for a large ship on that side of the world, except one, now nearly completed, at Sydney. It is scarcely necessary to observe that each succeeding year renders the want of dry docks in the Pacific more keenly felt, because the number of large steamers increases so rapidly.

Any such docks should be surrounded, not covered (unless at a considerable height), by ample roofing, so that all works necessary might be carried on irrespective of the weather. The utility

of such an undertaking would be so great, that undoubtedly the projectors of the "Gigantic Canal" will not omit to plan docks on a scale corresponding.

We can hardly quit this subject without referring to the claim made by the Panamá Railroad Company to bar all other parties from effecting any means of transit across the Isthmus included in New Granada. According to the old Spanish boundaries, as shown in numerous maps, the province of Panamá is separate and distinct from that of Darien; but the Government of New Granada have nevertheless caused their deed of grant in favour of Messrs. Fox, Henderson, Brassey, and Cullen, to be so worded as to save the claims of some other grantees, and thus to leave open a source of detrimental litigation.

A French Company has lately obtained a grant to work gold-mines on the Marea river, and, among other parties, are earnestly striving to monopolise the Cana district, whence so much gold was carried formerly.

An accurate and complete survey would soon show the real basis on which an ample amount of capital might be invested securely; and then, if as satisfactory in its results as is anticipated, there will be the strongest grounds for reasonable encouragement and support from Government.

Publications of ascertained value, and numerous other authenticated statements, have teemed with statistical accounts, arguments, and nautical calculations, which it would be as tedious as unnecessary here to recapitulate in detail. It will now suffice to say, that if such an inter-oceanic communication can be completed, it will immediately be used, not only by all ships bound to Western America (N. and S.) as well as by all the Australasian commerce, but by the whole of the China trade, and a considerable portion of that with eastern India. It will not be a question solely of distance, but of avoiding the Cape of Good Hope, as well as Cape Horn, and making the whole passage, out and home, in comparatively fine weather through seas seldom dangerous.

It is impossible to overrate the importance of this immense enterprise—this proposed intersection of the Darien Isthmus.

Having thus endeavoured to make a fair comparison between the peculiarities, geographically considered, of seven sections of the Great Isthmus of Central America, and to show which of them may become the best site for a ship-canal, let us conclude by expressing an earnest hope, that the great maritime powers will unite in guaranteeing the political security and absolute neutrality of an undertaking so universally beneficial.

XVI.—*Notes of an Excursion from the Banks of the Atrato to the Bay of Cupica, on the Coast of the Pacific, in the year* 1827. By Lieutenant (now Commander) Charles Friend, R.N.*

Communicated by Dr. Wm. Hamilton, R.N., through Captain Barnett, R.N., F.R.G.S.

Read June 13, 1853.

Notwithstanding the interval which has elapsed since Captain Friend's visit to Columbia, from which the notes of the following excursion have been extracted, in the absence of any other account of the interesting tract to which it refers, from the pen of an eye-witness worthy of credit, they possess all the freshness of novelty, combined with all the charms of truth; and we feel deeply indebted for the liberality with which Captain Friend has placed his information at our disposal. It is, however, a source of infinite regret to us, as we are confident it must be to our readers, that the objects of Captain Friend's mission did not combine scientific observations with those of a more commercial character, which produced his visit, and that the following notes, however valuable in other respects, furnish us with no astronomical, hypsometrical, or geological data upon which we might found any probable opinion as to the practicability of forming a navigable line of communication between the basins of the Atlantic and Pacific in this direction.

Captain Friend furnishes, however, some valuable information with respect to the breakers which extend from Punta Caribana (lat. 8° 38′ N., long. 76°·55′ W., Arrowsmith's Chart), the excellent shelter and anchorage under Punta Arenas (Punta Arenas del Norte, lat. 8° 33′ N., long. 76° 59′ W.; Punta Arenas del Sur, lat. 8° 33′ N., long. 76° 59′ W., *idem*), and the mouths of the Atrato, which are, he says, most incorrectly laid down in the very best charts. For passing the breakers he gives the following directions:—

"The best mark for running through these dangerous rocks, which extend about 4 miles N.W. from the land, is to steer direct for a solitary rock about ½ a mile from the land, on which the sea breaks with tremendous fury; and, when within about ¼ of a mile of it, alter the vessel's course so as to pass it tolerably close, either on the inside or the outside. We kept outside, passing in from 4 to 4½ fathoms water, and making allowance for the current, which usually sets out of the gulf in the direction of the reef, on which the sea was constantly breaking."

The Liberador steamer, in which Captain Friend was embarked, having passed these dangerous rocks unharmed, came to an anchor under Punta Arenas in from 5 to 15 fathoms, with protection from every wind except that blowing from the S.W. or bottom of the

* Extracted from Captain Friend's unpublished 'Notes and Observations made during a Visit to Columbia in the years 1825, 1826, and 1827.'

gulf. Here he determined the latitude, by meridian altitudes of the sun, to be 8° 30′. Excellent water is found within 20 yards of the shore, and fish of good quality is abundant. This anchorage is much frequented by vessels from the Atrato waiting for a wind to proceed to Carthagena. The current he found setting out of the gulf at the rate of 1½ knots an hour. He observed the latitude of Punta Cayman Viejo to be 8° 24′ 30″.

The Atrato discharges its waters by 5 mouths, as follows:—

1. Boca Arena, the most northerly, lat. 8° 15′ N. The depth on the bar does not exceed 6 feet in the dry, but reaches to 9 feet in the rainy season and high tides. The channel wide; bottom hard sand.

2. La Reversa, opening into the bay of Candelaria, in which is excellent anchorage in from 18 to 3 fathoms, with regular soundings.

3. Candelaria.

4. Boca de las Pavas: lat. 8° 6′ 30″ N., with a bar having in some parts but 2 fathoms, over which, notwithstanding a considerable swell, the Liberador, of 75 tons, steamed without injury, after having been lightened. The breadth of the channel is about 100 yards, with deep water, free from shoals or islands inside. The breadth of the Atrato above this mouth is from 300 to 500 yards, with deep water and low wooded banks, within which is a swamp.

5. Barbacoas,* having a vigie, or look-out house at its entrance, and a large quay, off which vessels of burthen anchor to discharge their cargoes, while those of less draught enter and proceed on their voyage. The breadth of the channel is about 200 yards, and the bottom hard sand. The depth on the bar is 5½ feet in dry seasons, and 8½ in time of floods.

The Napipi (Naipi) enters the Atrato on its left bank, in the estimated lat. of 7° 25′ N.,† and long. of 2° 59′ W. of Bogotà. At this point the breath of the Atrato is about ¼ of a mile, and its depth in the middle of its channel about 10 fathoms. Its course, so far, is free from every kind of obstruction, and its current, except in freshes, about 2½ miles an hour. We shall here leave Captain Friend to speak for himself.

* According to a memoir drawn up on the spot in 1825 by Sen. Francisco Martin, ex-governor of the province of Carthagena, the Boca de Barbacoas is situated in 8° 12′ N. latitude. We have no means at present of verifying the correctness of this position. It is not improbably too far S.

† Sen. Francisco Martin, in the memoir above quoted, assigns to the confluence of the Atrato and Napipi a latitude of 6° 33′ N. This, however, must be an error, since it places the confluence 8 miles to the S. of the point where Captain Wood observed the latitude in the bay in 1849, and would make the direct distance between the two points only 40·77 nautical or 47·22 English miles, nearly W. by N. It is therefore probable that Captain Friend's estimate of 7° 25′ is nearest to the truth.

Monday, 10th September, 1827.—Entered the Napipi. The entrance is about 30 yards wide, and the water 3 fathoms deep, but nearly stopped up by drift-wood. Remained to breakfast, and at 9 were again detained by fallen trees, which occupied us till 10 30 in cutting through, when we proceeded. Shot an eagle, 6 feet from tip to tip of its wings, and very powerful. At 4 15 stopped and erected a rancho, in which, with the assistance of our tolda, we passed a tolerable night; but those who had no tolda suffered much, as a heavy storm drove the mosquitoes in, in great numbers. Distance during the day 20 miles.

Tuesday, 11th.—Started at 6 15 A.M., but were frequently detained by fallen trees. Shot a quatia and several turkeys, which were very numerous. Passed several small falls. Stopped at a playa, and slept in a rancho. Made about 27 miles.

Wednesday, 12th.—Fine night. Started at daylight. Passed several plantations,* and stopped at the alcalde's at 10. At noon left, and at 12 15 stopped at Sen. Meriale's house. The banks of the river here are high and fertile, but in the months of September, October, and November, they have frequent floods, which injure the plantations much. We had sufficient indications of them by the branches of trees and grass left at a considerable height; but frequently years have passed without their being troubled by them. No vessel of any magnitude could ascend during this day, as, independently of the palisades or fallen trees, the river here has not at present above 3 feet of water, which is about its medium depth; and in the dry season it is a mere brook, navigable only by potros, or canoes of the smallest dimensions. Our host gave us a good dinner of wild hog, excellently dressed. We here discharged our peon, who was a lazy fellow, and hired two Indians in his place, one of whom was the capitan, or head man of the village.

Thursday, 13th.—Started at 6 40 with our two Indians, without rancho; the river here becoming very shallow, the rocky bed not having more than 1 foot of water. At 7 30 passed the house of the governor of the Indians, opposite the Ysla and Quebrada Merindo. At 8 passed the mouth of an interesting river called by the Indians Doado. At 11 passed a most interesting and romantic spot, with lofty and picturesque rocks on either side; the

* The first settlement, consisting of a few huts and plantains, is about 60 miles up, where the depth of water in ordinary seasons scarcely in places exceeds 3 feet; and from hence to the Tambo de Antado, or San Carlos, about 15 miles, it becomes still more shallow; at the time of our passing scarcely above one foot of water, and admitting only a small class of canoes. The banks of the river are high and fertile; plantains, maize, cacao, and other tropical productions thrive exceedingly well; but the numerous ants are destructive to exotic vegetables. The woods contain all the varieties of timber found in the province of Choco.—Captain Friend's 'Remarks on the Napipi.'

promontory covered with herbage, the river remarkably clear and tranquil, with a romantic rock in the centre. Above and below were several rapids. At 2 P.M. passed several rapids, which continued without intermission till 5 P.M., when we reached the Tambo de Antado,* a miserable shed with two elevated platforms quite open, and so rotten we feared it would fall upon us. We here found an Indian, his wife, and a party of three black youths, with a cargo of cocoa-nuts. Cooked some dinner, and betook ourselves to rest. This place was erected, by order of Government, for the convenience of goods and travellers to the Pacific. But few pass this way.

Friday, 14th.—The river was so swollen with heavy rain that we could not cross, so breakfasted, and went to see the hot springs said to be in the neighbourhood. These we found about ½ a mile from the Tambo. They were about 120° Fah., had a strong sulphureous smell, and are used by invalids for cutaneous diseases. The weather getting finer, and the river falling, we started on foot at 11 30; and at 12 30 descended a loma (Pie de Andes), and crossed the river. Crossed again at 1, and arrived, at 1 30, at a place called Yural, where we found a small rancho and a black man. Pursuing our journey over a high loma, we again reached the river, and crossed it at a place called Pie de Montana. Here the Napipi has forced a passage through the rock of not more than 3 yards wide, making a fall of several feet. The place is rocky, and the river, winding its brawling course between them both above and below the fall, has a very romantic effect. We again crossed the river at its confluence with the Rio Montata, which descends with equal force; and crossed again at 3 50 a little higher up. Finding we could not reach the sea before dark, we erected a rancho, made a fire, and passed a tolerable night.

Saturday, 15th.—Got a plantain and a cup of coffee, and started at 6 30. Crossed the river five times, the last at Chequero, at 7 10. The river is shallow here, and about 30 yards wide. It was at this place the boat of the Chilian frigate Andes, from the sea, was launched into the Napipi.† At 7 30 passed a quebrada

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* The Tambo de Antado. A shed erected by the Government for the convenience of travellers who pass this way across the isthmus. It is situated on an elevated bank of the Napipi, opposite a quebrada of the same name, from whence the road, or rather track, towards the Pacific Ocean commences, proceeding on the left side of the Napipi for about 3½ miles, when it is crossed at the foot of a loma (or small hill) called Pie de Ande, and which, having been crossed five more times, is finally left at a place called Chiquera; whence, taking a S.W. direction for about a mile, over nearly level ground, the Quebrada del Mar is met with, which discharges its waters into the Pacific Ocean; from hence passing the Loma del Mar you reach the Tambo on the sea-shore in 3 miles, or 45 minutes; being from tambo to tambo about 16 miles, or 5 hours.—*Ib.*

† Captain Friend here labours, perhaps, under a slight misapprehension as to the place of this event, as might have been presumed from his own account of the state

(Quebrada del Mar), which discharges its waters into the Bay of Cupica. At 8 saw the Pacific Ocean, and arrived at the tambo on the shore of the bay at 8 30. The bay is very beautiful, about 7 miles wide, and 9 deep. The shores are covered with wood. There are several small bays in it, with excellent water near the tambo, and limes and oranges. Breakfasted and embarked with our baggage in a piragua we found on the shore, at 10 30, and arrived at an Indian tambo, on the opposite side of the bay, at 12 15. Here we found a few Indians and a Mulatto making a piragua. They have one which goes occasionally to Panamá, which frequently occupies them 15 days, as they coast it along the shore and sleep at night. We found a few shells on the beach. Turtle are occasionally caught, but they are not numerous.

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of the river and the Angostura de Montata, between Chequero and the Tambo de Antado; at which last the launch really took place, as will be seen by the following, which, coming from the pen of the lamented patriotic and talented Sen. Cardeñas, who was one of the unfortunate victims that perished in the Amazon, on the 4th of January, 1852, merits every confidence, as Sen. C. resided at Quibdo, where he edited the 'Reverberacion Mercantil del Atrato,' in which paper he inserted an article on 'La Situacion del Rio Atrato, emparejada con aquella de la Mar Pacifico,' on the 20th of May, 1834, in which the affair is thus related:—"In the month of January, 1820, when, by a general combination, the Spaniards moved their forces towards the interior of N. Granada, and invaded this province [the Choco] by water, with the troops they had in Carthagena, the governor, Colonel Cancino, was at the port of Buenaventura, where the information of the Spanish movements reached him. The captain of the frigate Andes, John Illingworth, which was lying there, offered his services for the conveyance of Colonel Cancino [who had decided on attacking the enemy on his flank] in his frigate to the Bay of Cupica. Here it was observed, that after crossing the forests which interposed between the Pacific and the western tributaries of the Atrato, they would be unable to continue their progress, unless furnished with canoes. To meet this unforeseen difficulty, Colonel Cancino had a six-oared launch belonging to the Andes dragged across the isthmus —an operation which occupied 10 hours, part of which was consumed in cutting down the bushes which obstructed the path, when the boat was relaunched on the Napipi, and conveyed the colonel and his suite without difficulty to this city [Quibdo], where the boat was seen by the whole population, and where it has been suffered to fall to pieces and rot. If this fact can be considered of any consequence, it is certain that we relate it with entire confidence on the spot, and in the presence of above 8000 contemporary witnesses. Colonel Cancino, Captain Joaquim Andrade, the doctor of the frigate, and a person named Deserein, were the individuals composing the party which descended the river to the village of Murri, where the enemy was supposed to have been encamped. Of this number we know that Colonel Cancino, who descended the river, and Captain Illingworth, who superintended the operation of carrying the boat across the isthmus, are yet alive." Thus far Sen. Cardeñas. Now, upon referring to the narrative of Captain Friend, it appears difficult to understand how the launch of a frigate, laden with so large a party, and large enough, as Sen. Coutin acquaints us, in a letter of the 16th of January, 1835, "to carry fifteen armed men," could find water in the dry month of January to float her in the broad but shallow babbling stream which, flowing past Chequero, fordable with ease at all points, rushes in an impetuous cascade through the narrow strait of Montata; while we learn from Humboldt that the Embarcadero, or usual place for the shipment of goods, was at the Tambo de Antado, which, under ordinary circumstances, was regarded as the highest navigable point of the Napipi.

Sunday, 16th.—Got extra Indians, and visited the western side of the bay.*

Monday, 17th.—Embarked our stores, and started at 6 10 across the bay, accompanied by some Indians in two canoes. Arrived at the tambo at 8 30. Having breakfasted and bathed, we commenced our return at 10 30. Ascended the hill, and reached the Quebrada,† which discharges its waters into the sea, at 11 5. At 11 20 reached the banks of the Napipi, having been just 50 minutes crossing the Cordillera which divides the two waters; and shortly after arrived at Chequero, where we crossed the river; forded it three times, and reached our former rancho at 12 15. Arrived at the Montata at 12 40. Crossed the highest hill, which occupied us till 2 10, when we reached Yural, where we made a fire and warmed ourselves, the rain having fallen in torrents for the last two hours. Quitting Yural at 2 50, we reached the Tambo de Antado at 4. Here we got dry clothes, and found everything as we left it.

XVII.—*The Mines of Copiapo.* By Colonel J. A. Lloyd, F.R.S., F.R.G.S., H.B.M. Chargé d'Affaires in Bolivia.

Communicated by H.R.H. Prince Albert.

Read February 24, 1853.

On glancing over a map of South America, in about latitude 27° 20′ S., on the west coast there will be observed a small bay, or rather roadstead, bearing the name of Copiapo; and some 50 miles to the eastward in the interior a city is laid down named San Francisco de la Serva.

The port is now generally known as Caldera, one of the stopping places for the Pacific Company's steamers; but San Francisco, or "*The City*," as it is more generally denominated, is the modern Copiapo and capital of the province of Atacama.

But for the Copiapo British Mining Company, it is more than probable that the little that is yet known of this country would have been still more limited, and had it not been for British energy

* It is surrounded by beautiful hills, and contains several minor bays; but being exposed to the S.W. could not be considered good anchorage for shipping during the prevalence of winds from that quarter. The best anchorage is on the Cupica side, where the Punta de la Cruz (a little to N. of the parallel of 6° 41′) nearly shuts in that of San Francisco Solano (6° 15′ N.). The small river Cupica here discharges itself into the sea. The water is excellent, and affords much facility for watering ships, which may also procure oranges, lemons, cocoa-nuts, &c., from the Indians in the neighbourhood.—*Ib.*

† This quebrada is about 1500 yards distant from the Napipi. It enters the bay near the tambo on the shore, and admits of being rendered navigable by deepening, and employing locks.—*Ib.*

and capital, its riches in mines would possibly not yet have been revealed.

For several years the company above named has existed, or rather struggled to exist, deriving only scanty returns by the extraction of some rich and some poor copper-ores, raised to the surface of the most arid, yet perhaps the most healthy country on the face of the globe, without a sign of vegetation of any description, without fuel or water,* absolutely without any resources but its mineral wealth, a desolate, sandy desert, intersected in every direction by the most bare, rugged, and forbidding-looking mountains, inhabited by no living creatures, animal, bird, beast, or insect, excepting a few wretched wanderers, in the shape of "cateadores" or mine hunters, or the far-sighted vulture, soaring in mid air to descry the prey, which so surely and so often sinks with fatigue and thirst on the plains below, or, perched moodily on some neighbouring rugged crag, digesting its horrid repast.

Within a circle of some 90 or 100 miles still more inland, or rather N.N.E. of "The City," are studded the solitary and most melancholy-looking establishments of the mining Company, under the superintendence of certain hardy Cornish miners. At this great distance, under many privations in such a country, the miners perseveringly despatch the copper ore to the nearest shore—about 50 to 70 miles land carriage—to be conveyed in ships from thence, a four months' tempestuous voyage round Cape Horn to the smelting works of Swansea.

These establishments are on the southern boundary of the terrible desert, which stretches to the snow-capped Andes to the east, thence seaward to the very shores of the barren coast of Chilé, and forming one vast wilderness of sand through the so-called desert of Atacama, and then for hundreds of miles to Bolivia and Peru.

Yet, in these inhospitable regions, concealed beneath the surface, and in many instances above it, are found incalculable riches. In every direction veins of the purest silver ore (besides copper, lead, iron, bismuth, cobalt, antimony, arsenic, and quicksilver) intersect the whole province of Copiapo or Atacama.

It will hardly be believed that on every side of the establishments of the British Mining Company, and even within view, are to be found the richest silver-mines on the globe, distributing wealth and independence to hundreds of families, endowing the country with vast resources, and creating a branch of commerce with Great Britain, which is rapidly increasing beyond all precedent, and has hardly any limit but that caused by the scanty and utterly inadequate population, the difficulty of transit, and the enormous expense for provisions and materials.

* Five years have sometimes passed without a single shower.

On all sides, almost daily, new silver-mines are discovered, sometimes under the very threshold of the copper-mining establishments; offering such profitable investments to the company's servants, while the interests and speculations of that body are confined to the sluggish workings of their own minerals.

It is no rare occurrence to find a "barra" or share of a new mine, (twenty-four of which compose the property of a mine in these countries), which was originally purchased for from 200 to 500 dollars, rise in price in the course of a short time to 10, 20, 50, and even 80,000 dollars. It was only on the 10th of May that a "barra" or share in a mine of some promise was offered for "15 ounces," that is, about 51*l.*, which was purchased by a Señor Lemos. On the 12th a new "alcánce"* was fallen in with. On the 16th the owner was offered 5000 dollars (1000*l.*) for his share or twenty-fourth part, and, when the writer left on the 20th, the barra was quoted at 25,000 dollars, or 5000*l.*

The two great mining districts in this country are, Los Tres Puntos and Chañarcillo (stunted bush). Los Tres Puntos, so called from three pointed, but not very remarkable mountains in the centre part of this region, is 30 leagues by road from Copiapo, about N.N.E.

The Colorado Mine, which is in the close vicinity of these peaks, is 6584 feet above the sea, and one of the peaks 7680.

Chañarcillo is some 16 leagues to the south of Copiapo, and contains mines of native and other silver of such wondrous richness, that a narrative of their produce would almost rival a tale from the Arabian Nights. The mines of Tres Puntos, at least the small proportion as yet discovered, are dispersed over a great area.

From the summit of one of the high mountains, the horizon is bounded in all directions by other ranges, separated by parched sandy plains and valleys, in which are seen the remains of immense river beds, formerly exposed to the most violent action of extensive and very rapid streams, now without the slightest sign of vegetation, and in a country too where for many years past hardly a shower of rain is known to have fallen on the parched earth.

Under one view may be discerned mountains of dark-coloured limestone; quartz and porphyritic rocks of every colour and shade, intersected by rugged hills of clay slate and calcareous shale with their strata upset; distorted in every direction, in such utter chaos, such a mass of confused débris, as to have the appearance of great cities destroyed by some terrible earthquake, and afterwards discoloured by fire. Perhaps in their immediate vicinity, the eye will be alternately relieved and charmed, by reposing on isolated patches and streaks having every colour of the rainbow, from the

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* "Alcánce" a guide, or guia, followed until it turns out profitable.

green of the most luxuriant vegetation, to the most brilliant yellow and red, pointing out the localities of immense deposits of copper and oxydes of iron. The whole forms a landscape, which when exaggerated by the tints of a setting sun in this pure atmosphere, with the varying hues gradually subsiding from the more brilliant colours into a rose, then a purple, and lastly a fading neutral tint, is so surpassingly beautiful, that the wearied traveller is enchanted and amply rewarded for the toil he has encountered; and the resting-place which may be yet many leagues distant appears, from the extraordinary illusion caused by the calm and transparent atmosphere, to be almost immediately at his feet.

The mines of Chañarcillo are different, and are almost exclusively confined to a spur of one of the mountain ranges, and the plain or valley in its vicinity. The mountain itself is one huge mass of very hard and almost black limestone, with a softer and lighter calcareous rock, intercepted by and alternating with immense beds or "mesas" of a very tough and horny limestone of a deep brown and almost waxy appearance. They vary in thickness from 80 to 120 yards, and no less than seven of these mesas have already been pierced through. There are occasionally almost vertical dykes of this horny limestone passing through the other.

On the plain beneath, the village or town of the Placilla, or Juan Godoi, is flourishing, unhappily notorious for its unbridled pleasures, its vices and gambling, and its temptations to the miners.

On looking upward to the very summit of the hill, which is about 4500 feet above the sea, the whole steep scarp appears studded with immense steps of débris, with huge buttresses to support them; these are the mouths of the various mines. Perched on these resting-places are discerned the numberless houses, huts, and other belongings of each "mineral," and the whole mountain seems covered with them.

On all sides range after range seems to inclose this little plain, towering up higher and higher; at last, in one direction the pure and azure sky is darkened by massive clouds, above which are discerned, like bright points of molten silver, the snow-capped summits of the far distant Andes.

To the left, apparently hanging over Chañarcillo, but really three leagues distant, are two remarkable mountain tops, called Los Frayles, or the "monks," which contain the richest treasures in quicksilver.

The fame of the silver-mines of Copiapo is of very recent date.

It was only some twenty years since (in 1832) that a poor Chilean muleteer, named Juan Godoi, was, one 18th of May, hunting a guanaco in this unpeopled wilderness.

Having wounded his game, he had pursued it until he was so utterly overcome with fatigue and thirst, that he could advance no

further: he sank down on a neighbouring rock, trusting that on the return of his dogs their reddened mouths would show whether they had come up with their victim.

In a few moments Godoi found that he was seated on a rugged block of pure silver, which had crested out from a vein immediately beneath. From this instant Chañarcillo took its birth as a rich mining country, which has endowed the republic of Chilé with great wealth.

Some 800 feet above the administrador's house, and at the summit of the hill, is now seen a small excavation. It was immediately after Godoi's discovery that a poor peon, named Bolado, slept beneath a projecting crag, and in the morning found that his frugal fire had brightened a portion of the wall of his resting-place: that wall was the outside of one perfectly isolated mass of pure and solid native silver. When all cut out it yielded 2800 marcs to the fortunate owner, but no indications whatever were found of a vein beneath.

Discovery then followed discovery, and rich was the spoil that was gathered for a time from the veins which had been opened from the surface. The returns, however, gradually diminished, until at length, in 1836, the miners almost simultaneously came down upon one of the "*mesas*" of hard rock, called in the language of the country the "mesa de piedra," "the stone table."

Such was the condition of the mines of Chañarcillo generally in 1836, when the patron, José Miguel Gallo, a Chilean, and owner of Descubridora, found his richest veins end at this stone table, and determined to embark all his remaining capital in one hazardous enterprise.

He had little education and as little experience in mining or geology, but, encouraged by the beautiful old Spanish proverb,—"*Tóda flór tiene su raíz*" (Every flower hath its root), he determined to sink shafts through this adamantine cloak or "manto." Fathom after fathom was industriously pierced in several places, but the "mesa" seemed to extend to the very bowels of the earth. Gallo sickened with disappointment, his friends deserted him, his means were exhausted, he was ruined; still he persevered. His high-minded and spirited wife became a teacher at a small school; his gallant sons, as they considered the miner's pick a disgrace, went to work in the "buitron," treading out with their naked feet the amalgam of mercury and silver.

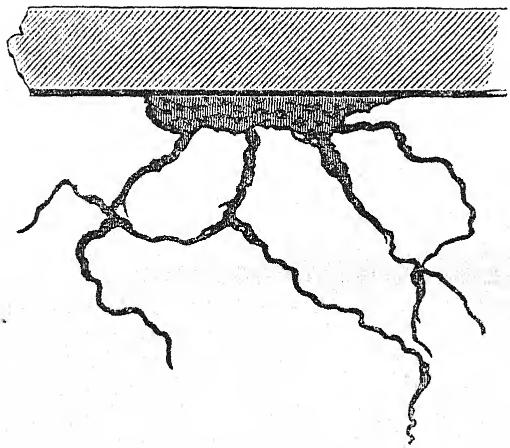
At last fortune smiled suddenly on Don José, and on his family—the barrier was at last pierced through at a depth of 266 feet, when riches beyond their most sanguine hopes were revealed to their ravished eyes—vein after vein, band after band, of rich native silver were found by the eager adventurers.

Gallo's example was then quickly followed by the other pro-

prietors, who took up their shares again, and every one was rewarded with a treasure beneath the "mesa." Vast wealth was collected, and the descendants of Gallo possess the richest inheritances in Chilé.

It is now a notorious fact throughout the Chañarcillo district that whenever a "mesa" or a dyke of this horny limestone occurs—in the first case the vein is lost, but, sinking through the immense cover, it is again encountered, richer than ever, and crowned by a mass of pure silver, varying in weight from hundreds to even thousands of marcs. It appears as if the liquid silver had been injected by force through the innumerable fissures upwards, until it had been resisted by the enormous superincumbent weight of the "mesa" of hard limestone, when, as

Mesa.



long as the metal remained liquid, it insinuated itself into a condensed mass in every possible direction where it found the least resistance.

In the second case of the dykes, this wonderful phenomenon takes place on both sides the wall; for when any of the veins come to the great dyke they spread out into large branches and masses of native silver, and immediately on the opposite side a corresponding mass is found, which is the "guia" to another rich vein, subsiding gradually to its usual dimension, from 5 to 2 inches in width, from 6 to 10 feet in depth, having generally on either side crystallized and massive calcareous spar, with an outer laminiferous coating, from half an inch to two or more feet in thickness, of a very red carbonate of lime, and known as the guide or "guia" to an argentiferous vein.

The most important mines at Chañarcillo are San Francisco,

San Francisquito, the Descubridora, Candelaria, Colorada, Valenciana, Esperanza, Manto de Manduola, Manto de Ossa, Guias de Carvallo, San José Juanaca, Desempeño, San Felix, Santa Rica, El Delirio, &c.

To give some idea of the riches drawn from these newly discovered and only partially worked veins, the mine of San Francisco may be adduced. It originally belonged to Don Ramon Goyonechea, and since 1832 has yielded large returns, and now appears to be one mass of silver, richer than ever.

The mines of Tres Puntos are equally rich both in silver and romance; they were utterly unknown some four years since. They too owe their discovery to pure accident. In the year 1848, a poor Indian, a "chango"* named Osorio, had been employed as a courier from Copiapo to the copper-mines still farther north than Tres Puntos. During a journey from the city to the mines of Salado, Osorio, borne down with fatigue and benighted, had reached the valley near the mountains which have since given the name to the mines, when his mule gave such signs of distress that he well knew, if further urged, would end in her sinking never to rise again.

The hardy courier made up his mind for the worst, and picketing the poor beast close to him, laid down to await the first dawn. He slept soundly, the sun was high on the mountains before he awoke to find his mule had torn the little mining bar from the picketing place, and strayed some distance, although yet in sight. Osorio was soon up with his companion, when he observed the end of the mining bar glistening with silver.

This was the origin of the Esperanza mine, which now bears a value in the market of 16,000*l.* per "barra" or 24th, their total being 1,920,000 dollars, or 384,000*l.* By the last monthly return to the Juez, the investment has yielded a profit on each share of 4000*l.*, all expenses and interest at 12 per cent. on the capital having been first paid.

Since that late period strata after strata have been laid open, mine after mine denounced, and now there are some 59 mines in work, among the most profitable of which are, Salvador, Oriente, Esperanza, Colorado, Luz del Pilar, Carmen Alto, San Francisco, Despreciada, San Antonio, Baldomera, Belisario, Manto Grande, Toledo, Lola Montes, Al fin Hallada, &c. &c.

There are besides in several other districts in the vicinity a number of mines, as at Pajonales, Bandurias, Garin, Romero, Sacramento, &c. There are in all 235 silver, 14 copper, and 6 gold mines in the department of Copiapo alone, and there are a great number of others in the districts of Atacama.

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* A chango is of the race who inhabit the coast, and are fishermen.

The discoveries in Los Puntos have been attended with loss of life from want of water at the outset. Numbers of horses and mules died during the first few weeks, and eight cateadores or mine-hunters were known to have been lost, besides many others who have never been heard of.

It is only by others passing some unfrequented place in this terrible desert that human remains are found, the skin and skeleton so perfect as to have the appearance of a fresh mummy. The form remains perfect, and the features can be easily distinguished, the dry climate having produced this wonderful effect. The bodies of mules at almost every mile are observed, comparatively as light as feathers, and some in the most striking positions, having died in the very act of leaning against a rock, others while vainly attempting to nibble a last atom from, here and there, some miserable and stunted thorny bush.

No water of any description was to be found at first within 30 leagues of the mines. A 9-gallon cask of brackish water cost 8 dollars, or 1*l.* 12*s.*, and the baiting of a horse or mule was 15 dollars, or 3*l.* Since that period the price has gradually fallen, and several wells have been sunk. But as yet the only drinkable water comes to the mines from wells at Los Puquios, about 10, and Sierra de Vacas, about 5 leagues from Tres Puntos. The small barrel costs 8 reals (4*s.*) from the former, and 9 reals or 4*s.* 6*d.* from the latter, which is also the best water. The sum of 2000 dollars or 400*l.* was a few days since paid for a well of indifferent water 11 feet deep.

At Chañarcillo the water is brought up to the mines on the backs of donkeys from many leagues' distance, and the quantity furnished to an establishment forms a very important item in the accounts. At the Delirio the cost of water annually is 2000*l.*

Export of Silver.—In the year 1832 to 1836 the exports varied from 60,000 marcs of pure silver to 90,000, decreasing to 18,000 in 1836. At the present time the exports of native silver or "plata caliente," as passing through the Custom House, amount to 400,000 marcs, and by far the largest proportion, which is called "piedra fria," or those not reducible by mercury, go to Europe in the mass. These comprise the richest sulphurets, yielding, as in the ruby silver, termed "rosicler," as much as 40 to 45 per cent. antimonial and arsenical silver, the former sometimes giving 73 per cent. of silver, and other vast quantities yielding from 5 to 20 per cent.

Chañarcillo alone in less than ten years produced more than *twelve millions of dollars*, and in 1851 *seven millions of dollars*, for all metals, were shipped in value at Caldera alone.

The Port of Caldera.—The Port of Caldera, now a rapidly rising town, possesses a good landing wharf and mole, with 24

feet water, at which ships of 800 and of 1200 tons have discharged cargo. There is a large and handsome two-storied custom-house, storehouses, shops, and hotels, guard-house, &c. There is a convenient railway station, which would do honour to the provincial town of any state; and there is a large machine shop, furnished with some of the most admirably finished lathes, planing, slotting, and drilling machines, worked by a 20-horse engine.

All this is due to the energy of Mr. Wheelwright, the original and successful projector of the Pacific Steam Navigation Company, whose line of vessels are now so complete, that there is a certain communication from the whole distance of Valparaiso to Panamá every 14 days, in both directions. Mr. Wheelwright has been ably assisted by two eminent American engineers, Mr. Allan Campbell and Mr. Evans. Eighteen months since Mr. Evans landed at the miserable and then insignificant Port of Caldera, and, finding no hut or accommodation, passed the night in a fisherman's rancho on the beach.

The road to Copiapo, 50 miles distant, was through the most hopeless waste, with neither water nor vegetation. The whole plain was bleached with saltpetre and other salts lying some depth on the surface.

The journey occupied a whole day, a day of great suffering from the intense heat, and the clouds of suffocating dust, surpassing even the transit from Suez to Cairo.

The journey is now daily accomplished in less than three hours to Copiapo, 1213 feet above the sea, in most comfortable carriages, with sofas, &c., holding some 50 persons each, and securely hung on four pairs of wheels, and trussed bearers.

The locomotives are equally elegant, worked with coal or wood, drawing a very large tender, the tanks filled with water, every drop of which is distilled from the sea at Caldera.

To crown the whole of Mr. Evans's undertaking, an excellent railway station greets the well-pleased traveller on his arrival at Copiapo.

[Remarks.—On perusing the few desultory notes, which have been made during a rapid and fatiguing journey over the districts of Chañarcillo and Tres Puntos, it will be probable that a stranger to this part of the world, or even a geologist having only the experience of the metalliferous districts of the Old World, may look with wonder, if not distrust, on a narrative attempting to describe the existence of such unparalleled riches, and, it is admitted, almost incomprehensible to those who have not passed through the country. The best guarantee in favour of the fidelity of the narrative will be an inspection of the few statistical notes which have been appended, collected at the mines and the "Intendencia."

It will not be unreasonable to infer, and which inference is borne out by facts, that on so extensive a coast, a tranquil sea, and an indifferent surveillance, it would not be difficult to escape altogether the payment of duties; and the Government returns for bar silver are very much less than the actual quantity exported.

Another collateral support to the statements of the richness of the country will be the specimens of the ores sent home with these notes. The greater part of them were detached by the writer's own hammer, or collected by him in the mines.

Many of these specimens will fully illustrate the richness of the veins, which are unparalleled in quality perhaps in the world.]

1st. At Chañarcillo the mines are generally worked through an obstinately hard limestone into not only veins but continuous bands and large masses of *native silver*, so pure and so rich as to require no other trouble than to be sent to the melting-pot.

Such are the mines of Descubridora, San Francisco, San Domingo, &c.

2nd. The richest veins of chloride and bromochloride of silver, both massive and semi-crystallized, are found in Descubridora and many others.

3rd. Antimonial silver, with a sulphuret called "Plomo ronco" (almost pure silver), is common to all the mines.

4th. Native silvers, filiform, arborescent, granular, and arenaceous, are found in all their varieties in limestone, in transparent calc spar, and often with sulphate of lime.

They are more or less rich throughout the district, and are classed under the name of "plata calida," as reducible, together with the chlorides or horn silver, by mercury, at the "buitron" or "maquina."

And lastly, the arseniurets are found in enormous quantities in all the mines, and a beautiful but rarely crystallized iodide of silver with the ruby silver are partially distributed, as at Descubridora, San Francisco, El Delirio, &c.

In "Tres Puntos" there have not been as yet found such rich masses of native silver, but it is amply made up in quantity by the smaller branch veins of arborescent and granular silver.

The prevailing mineral in the most valuable mines is the beautiful "rosicler," or ruby silver, found massive in large bands, sometimes more than six inches thick and several feet in depth.

They yield from 25 to 40 per cent. of silver.

Large quantities of the rich sulphuret, or "plomo ronco," occur with the "rosicler," with antimoniurets and arsenical silver and sulphurets of less per-centage, and occasionally, at both districts, bismuth and cobalt ores of silver.

All these latter are called "piedras frias," or not reducible by mercury. Thousands of tons are shipped to different countries in Europe to be smelted.

At the mines there still remain enormous mounds of ore, which have been picked over and rejected because not of the richest ore, but are left for more leisurely examination, when mule hire will have become more reasonable and provisions more plentiful.

It is computed that at Chañarcillo there are more than 300,000 tons of "piedras frias," piled in immense heaps, hitherto useless, and occupying the valuable ground in the vicinity of the mines. They are judged to have a "lei," or per-centage of pure silver of from 6 marcs or 48 ounces to 50 marcs or 400 ounces per ton, and at present without any available means whatever of reducing them. Within a day's sail of Valparaiso, however, at Talcahuano, close to the landing-place, extensive coal mines have been discovered, of which the surface has as yet been hardly pierced.*

The coal is light and highly bituminous, and is said to burn away very fast, leaving no cinders. Whenever the stock of English coals at the depôt fails the steamers are in the habit of using this coal, and it is said to get up the steam quickly and burn well.

There is no doubt that if these mines were worked to a greater depth, the coal would improve and come into more general use.

In many parts of the districts galena is found in quantities, although, in the profusion of the more valuable metals, it is not worked.

Limestone of every description, excepting the primitive, is in abundance in all directions. From Caldera to Copiapo the plains are covered with alkali; and the little port of Iquique, only two days' sail from Caldera, is frequented solely for the large quantities it possesses of saltpetre. Thus, in the immediate vicinity of these numberless silver-mines are to be found all the requisites for smelting. Yet not a single furnace has been erected on any part of the coast for such purpose, although within musket-shot of the mole of Valparaiso there is an establishment belonging to an English gentleman for smelting copper-ores considered too poor to send to England.

The chief causes may be attributed to the utter dearth of scientific knowledge, want of capital and population, indifferent means of communication, and consequent expense of transport.

The railway to Copiapo has, in some measure, alleviated the latter evil, for since it has been opened every description of provisions, carriage, and labour have fallen 30 per cent. The projector of the present railway has just entered into preliminary arrangements to continue the line 28 more miles towards Chañarcillo, to a place called "Puente del Demonio," or Devil's Bridge, for the sum of 500,000 dollars; and in a short time the spirited proprietors will not only have a railway to the Cuesta of Chañarcillo, but another will no doubt extend to the foot of the mines of that name, as well as to the heart of "Tres Puntos."

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* *See* Journal of Royal Geographical Society, vol. xx. pp. 151-153.—Ed.

APPENDIX.

Return of Silver-Mines worked in the Province of Copiapo in 1851.

District.	No. of Mines.	Miners, &c.	Other Population not in Mines.	Wells for Water.	Cost at Well, 8 Galls.	Cost at Mine, 8 Galls.	Donkeys employed.	Persons employed.	Cargoes Daily.
					Reals, 6*d*.	Reals.			
Chañarcillo	115	1677	1·049	73	2	9	763	136	821
Tres Puntos	55	629	248	26	3 to 8	8 to 12	57	42	
San Antonio	14	99	273	4	$\frac{1}{3}$	?	16	6	
Garin	17	148	25	6	2	4	10	5	
Sacramento	12	90	139	4	$1\frac{1}{2}$	4	26	9	
Romero	22	118	137	8	$\frac{1}{2}$	3	57	17	
Total . .	235	2761	1871	118	..	..	929	215	

During the year 1850, 153,987 cwt. of ore went to the amalgamation works.

Of the above number of mines, 85, chiefly in Chañarcillo and Tres Puntos, are yielding very rich and abundant ore.

The population of Chañarcillo has already increased more than double: of the 1049 in the placilla or town of Chañarcillo, 492 were men, and 457 women.

In the district of Copiapo there were worked in 1842—silver, 100; gold, 4; copper, 40. In 1850 there was a great increase in silver and decrease in copper; viz.—silver, 233; gold, 6; copper, 14.

Machinery is being gradually adopted, and the richer mines possess large shafts, with horse gear and drums: 40 are already put up.

The greater porportion of the provisions for Chañarcillo are obtained direct from Valparaiso to the port of Tortoral; nearer than Copiapo. The provisions are 30 per cent. cheaper than at the city.

Provisions are now also beginning to be landed for Tres Puntos, at a little port 25 leagues distant, called "Flamingo."

From the Official Return of the Intendencia.

Return of Silver in ingots and bars, &c., exported from Caldera during 1851.

Pure and Bar Silver.

	Marcs.	
First Quarter	134,203	6
Second do.	103,801	$0\frac{6}{8}$
Third do.	86,772	4
Fourth do.	54,082	0
Total marcs	378,859	$2\frac{6}{8}$
	or	
Total ounces	3,030,874	$0\frac{6}{8}$

"Plata fria," as ruby silver, sulphurets, antimoniurets, &c., not reducible by mercury, and varying in the amount of silver from 8 to 73 per cent.

	lbs.
First Quarter	457,929
Second do.	1,820,815
Third do.	8,533
Fourth do.	25,552
Total	2,312,829

No duty is paid, excepting on pure silver, and some of the richest native silver is exported as "piedra fria."

Exportation of Bars of Silver reduced in Copiapo from the Native Silver or "Plata Calida."

	Marcs.		Value. Dollars.	
1830	6659		59,931	
1831	5997		53,973	
1832	32734	3	294,609	3
1833	94149	2	847,342	2
1834	82782	1	745,139	5
1835	84700	5	761,405	5
1836	17204	3	154,839	3
1837	58449	1	526,042	1
1838	63615	4	572,539	4
1839	103765	2	933,897	2
1840	19248	7	173,239	7
1841	82112	1	739,009	1
1842	82840	3	745,563	3
1843	69199	6	622,791	6
1844	122994	3	1,106,949	3
1845	153447	3	1,381,030	3
1846	160793	5	1,444,142	5
1847	204104	4	1,836,940	4
1848	261105	1	2,349,996	1
1849	342239	5	3,080,156	5
1850	387019	$7\frac{7}{8}$	3,483,179	$6\frac{7}{8}$
Total	2,635162	$2\frac{7}{8}$	18,432,719	$3\frac{7}{8}$
	2,435162	$2\frac{7}{8}$	21,912,719	$5\frac{7}{8}$

Note.—It must be remembered that the native silver or plata calida forms only a small proportion of the ore and the value of the exports.

The Descubridora Mine, from the scanty population, can only command 230 persons, employed as follows:—

		Per Month. Dollars.
1	administrador	300
1	accountant	100
36	mayordomos, and watcher, varying from 50 to 20 dollars	1080
70	miners, the English having 45 to 50 dollars per month, the others from 12 to 17	1450
50	peons	750
60	labourers	700
3	blacksmiths	150
2	carpenters	100
7	servants	90
	£944 =	4720

or 11,238*l.* per annum for labour alone.

The 70 miners work on 64 different veins or places, 25 of which yield immense returns, 19 are opening out, and 20 out of work, or shafts. There are, besides, some 40 more workings, 20 of which would yield, but there are no labourers, although a thousand men could be employed.

The general direction of the veins is N. S. 6° 30′ East, the dip being little more than 4°. The mine is 180 yards deep, and they have not yet pierced what is called the "Mantos of Delirio," which is expected, as in all other cases, to be richer than ever.

The mean assayed percentage of the yield of the entire mine at the present period gives 200 to 250 marcs to the "cajon" of 66 quintals; that is, 528 to 680 ounces of silver to the ton!

With the above number of workmen, the profit last year was *one million of dollars!*

Salvadora Mine, belonging to Chileans; administered by a Cornish Captain.

	Monthly. Dollars.
Pay of administrador	105
4 mayordomos	147
71 miners and labourers, 10 being English	1128
Rations, materials, coal, general disbursements, water, and transport	549
Total	1929

or 385*l*. per month.

The quantity of silver ore sent into Copiapo in April, 1852, realised *fifty thousand dollars.* (Signed) Joseph Annear.

Maquinas, or Amalgamating Works.—Until very recently, the only means employed for obtaining the native silver from the ore was by the "buitron," still employed in Mexico, or treading out the amalgam of mercury and silver by the feet or by cattle.

A poor English mechanic in Copiapo, named Cooper, a watchmaker by trade, constructed a model of a complete set of machinery, with kneading-mills or tinas; but his invention was neglected, and even looked on with contempt, until an enterprising and intelligent merchant from Valparaiso saw it and appreciated its value.

Don Bernardino Codecido adopted Cooper's invention, and, in conjunction with an Englishman named Stephenson, obtained an exclusive privilege for seven years to employ this machinery. Stephenson died immediately after, and Don Bernardino erected and worked the establishment with immense profit.

There are now 18 maquinas, worked chiefly by water-wheels from a small stream from the Cordillera; there are also 28 crushing mills, 156 amalgamating tubs or "tinas," and 41 subliming furnaces, employing 388 people.

The following is a return of the quantity of ore reduced by Codecido's maquina in the month of April, 1852. It will show how much silver is extracted at one of 18 establishments, and the immense average "lei," or percentage of silver.

Return of Ore reduced at Codecido's Works for April 1852.

District.	Name of Mine.	Cargas, or Mule Loads.	Weight in Cwts.		Lei, or Number of Marcs in Cajon.		Products in Marcs.	
Chañarcillo . .	Colorado . . .	53	185	50	90		158	22
Do. . .	Desempeño . .	280	980		143	40	2190	
Tres Puntos . .	S. F. del Vol. .	17	63		71	50	70	44
Do. . . .	Al fin Hallada .	24	84		226	50	291	
Do. . . .	Do. . .	22	78		215	54	261	
Do. . . .	Do. . .	14	52		213		175	79
Ladrelles . .	Arcenico . . .	2	6		118		11	12
Pajonales . .	Miller	56	196		24	36	73	
Do. . . .	Descubridora . .	13	45	50	83	40	58	63
Do. . . .	Escurial . . .	..	0	60	2646		24	81
Chañarcillo . .	Delirio . . .	80	303		13	16	62	33
Checo . . .	Descubridora . .	26	91		44	60	63	50
Tres Puntos . .	Al fin Hallada .	17	60		219		205	12
Do. . . .	Do. . .	12	40		269		168	
Do. . . .	Do. . .	2	5		208		16	25
Do. . . .	Barcelonesa . .	189	661	50	80		831	70
Do. . . .	S. F. Volcan . .	36	136	50	85		181	75
		846	2988	40	4750	46	4942	68

Note.—Codicido's mill being in the city, is used more especially for experiments or new discoveries. The richer mines have amalgamating establishments near Chañarcillo.

SILVER ORE reduced at the Maquina de Cerrillos (on road to Chañacillo) in 1850.

Name of Mine.	Cargas.	Peso.	Producido.	Lei.	Rebaja.	Gastos.	Fletes.	Maquilas.	Importe de las Planillas.
					Dollars.	Dollars.	Dollars.	Dollars.	Dollars.
Manto de Ossa	85	297 50	1043 3 6	224 4	74 3	..	183 0	1025 1	1208 1
Valenciana	539	1956 50	5244 6 1	171 4	489 1	44 0	1230 1	4808 7½	6083 0½
Retamo	162	549 56	19279 7 3	2426 0	139 0	30 1	159 0	7339 0	7528 1
Delirio	2314	8100 68	33028 6 5	261 0	2906 7½	115 2	5166 0	23159 0½	28440 2½
Siete Denuncios	43	138 60	336 6 6	155 5	60 0	..	..	378 3½	378 3½
Manto de Ossa	3063	10720 50	8034 4 7	48 0	2026 1	273 1½	7242 4	12623 2	20138 7½
Descubridora	1580½	5530 39	16576 2 0	191 7	1384 4	761 7½	3789 3½	14544 2½	19095 5½
Carpas	72	252 0	293 0 5	74 3	63 0	23 7	190 4	402 4½	616 7½
Santo Domingo	161	556 50	584 3 5	67 0	140 7	25 7	427 6	795 4	1249 1
Rosario 1°	6½	22 75	31 0 2	87 2	5 5½	..	17 7	40 7	58 6
San Antonio del Mar	16	56 0	65 1 4	74 0	14 0	2 6	44 0	91 7½	138 5½
Ave M. Sacramento	3	11 90	32 4 0	175 0	..	..	..	35 2	35 2
Descubridora	30	105 0	119 2 4	72 4	26 2	5 4	82 4	167 5	255 5
Cobriza	215	752 50	191 0 1	16 2	188 1	11 0	591 2	384 7	987 1
Manto Peralta	52	182 0	78 5 7	27 5	45 4	..	110 4	162 4½	273 0½
Cuatro Amigos	16	56 0	21 5 0	25 4	..	..	36 0	64 7	100 7
Sin Pleito	7	28 85	12 3 4	27 5	..	..	..	37 2½	37 2½
Merceditas	2	6 91	66 7 0	249 0	..	..	..	26 7	26 7
San Ramon	28	97 0	378 2 0	249 4	24 4	..	59 4	353 6	413 2
Guia	97	339 50	938 2 6	177 0	99 2	..	..	1073 5½	1073 5½
Colleccion de Piedras	..	..	28 1 4	..	..	..	..	14 1	14 1
	8512	29761 04	86345 5 6	185 3	7627 2	1293 4	19329 7½	67529 7½	88153 3

To give an idea of the enormous profits shared by the owners of the maquinas, who have a monopoly of the water, a return is subjoined of the operations of one maquina for 1850.

It results that, for the reduction of 29,761 quintals of ore, yielding 86,345 5 6 marcs, the total charges were 88,153 dollars! and the profit to the proprietor for his amalgamating works, 67,529 dollars, or about 13,500*l.*!

As the different terms of the following table are technical, a glossary is given.

Carga—a mule-load of 25 arrobas.
Peso—a quintal of 100 lbs.
Producido—the quantity of silver in marcs.
Lei—the percentage or number of marcs in a "cajon," or 3 tons.
Rebaja—allowance or discount to proprietor, in dollars.
Gastos—incidental expenses, in dollars.
Fletes—payment for cargo mules, in dollars.
Maquilas—the charge in dollars.
Importe de las planillas—total amount of charges, in dollars.

Statement of the Expenses of shipping 300 tons, or 100 "cajones," of silver ore, called "piedras frias," or sulphurets, antimoniurets, &c., from Valparaiso to England. Received from one of the first mercantile houses there.

Data.—A "cajon" is equal to 3 tons, or 66 quintals, or to 12,800 marcs.

The "lei," or proportion of silver, was 400 marcs to the "cajon," or per cent. 3·125.

The freight paid was per ton 2*l.* 10*s.*

Summary of Expenses.

Freight	£750	0	0
Insurance	1,260	0	0
All the other expenses, including Custom-house charges, wharfage, storeage, and commission for sales in England, according to account current	2,370	0	0
Total expenses of 300 tons	£4,380	0	0

The following will be the proportion of charges for silver yielding 3·125 per cent., and for the useless ore sent with it:—

For 40,000 marcs of silver.

Freight	£23	1	0
Insurance	39	7	6
Expenses up to time of sale to smelters	74	1	0
Proportion of expenses for silver	£136	9	6

For 296½ tons of ballast or worthless rock.

Freight	£ 726	19	0
Insurance	1,220	12	6
Expenses	2,295	19	0
Total	£4,243	10	6

These are the expenses for carrying ballast to England.

The sale of 40,000 marcs of pure silver in England realizes, at 40*s.* the marc (it is more rather than less), the sum of 80,000*l.*; and it is assumed by the merchant, that if the assays have been carefully made and the purchases fair, he will realize a profit of one-eighth, or 10,000*l.*

From the above memorandum, even if approximating to truth, it will be seen what an enormous loss is sustained by the mining proprietors; and what sums might be realized by smelting on the spot, and giving a profitable freight to ships coming out in ballast, by bringing out cargoes of coals at the rate of 2*l.* per ton, the average low market price for English coal at Valparaiso. Assuming the loss on carrying stones to England, as set forth, more than 2000 tons of coal could be brought out for smelting.

But as an inexhaustible supply of quick-burning coals could be obtained at Talcahuano (Concepcion), for from 8*s.* to 16*s.* per ton, it is suggested whether coke could not be sent out instead of coal, when, by a better appliance of machinery and using stamping-mills, great economy might be introduced.

STATISTICS of the CALDERA and COPIAPO RAILWAY.

Estimate.	Dollars.
Cost of grading, tracklaying, superintendence, engines and bars, stations, water-deposits	943,000
Land	50,000
Right	10,000
Pier	60,000
	1,063,000
Extras	60,000
	1,123,000
The capital paid up	1,150,000
Received for surveys of road	50,000
	1,200,000

The extras were for a coal-deposit for the Steam Pacific Company, and apparatus for distilling water.

The whole cost of the railway, including extras, is put at 1,250,000 dollars, or 24,753 dollars per mile, which includes bars and locomotives sufficient to transport 60,000 tons of goods, a well fitted and filled workshop, and stations; everything complete.

The iron used is 56 lbs. per yard; sleepers 7 feet 6·8 in. × 6.• The maximum grade, 63 feet to the mile; the total elevation to Copiapo, 1200 feet.

The engineers arrived in April, 1850; the first sleepers was laid in December, 1850, and the road opened for traffic 28th of December, 1851.

The revolution which followed retarded the work and limited the traffic; the present income is 30,000 dollars (6000*l.*) monthly; but next year, when the copper-mines come into activity, the income will be 500,000 dollars.

There being no bridges, nor rain, the road will be kept up at a trifling expense.

The exports of metals from Copiapo for 1853 are estimated at no less than 10 millions of dollars, and no copper is sent under a yield of 25 per cent. from the ores.

XVIII.—*On the Rio Negro.* By Mr. ALFRED R. WALLACE.

Communicated by Mr. PETERMANN.

Read June 13, 1853.

THE Rio Negro, or "Black River," is one of the largest northern tributaries of the Amazon. It enters that river at about 800 miles from the ocean, while near its source it communicates, by means of the Cassiquiare, with the Orinoko.

The most striking characteristic of the Rio Negro is that from which it derives its name—its black waters. And this is no imaginative or fanciful appellation; forasmuch as the waters of the ocean are blue, so are those of this river jet black. The sudden change from the pale-yellowish olive of the Amazon is most striking, and must have immediately suggested its name to its

first European discoverers. The water, when examined in a glass vessel, is seen to be very slightly tinged with a clear coffee brown; and where it runs over white sand, at the depth of a few feet, it appears of a rich golden brown colour. In deep water it is, in every variety of light, *jet black.*

The colour varies in intensity in different parts of its course. In the lower part there is slight olive tint, caused by a mixture of sediment; higher up in the rocky district it is much purer and more transparent, and towards its sources above the falls, and in its smaller branches, the water attains its maximum of purity and colour. The tributary streams vary much in this particular. All on its southern side, above those which communicate with the Solimoẽs, are black, the great river Uaupés alone being of a rather paler colour, though it, too, is a black-water river. On the N. side, also, there are some black-water streams, though the greater number are white. The small streams below the Rio Branco are black. That river, however, is white to a remarkable degree, its waters being actually milky in appearance. Above it, the Darahá and some other small streams are black, while the Padauarí, Maravihá, and Cababurís are white-water rivers, though none of them so much so as the Rio Branco, or even as the Amazons. Other small streams flowing between them have black water.

These various-coloured waters may, we believe, readily be accounted for by the nature of the country the stream flows through. The fact that the most purely black-water rivers flow through districts of dense forest, and have granite beds, seems to show that it is the percolation of the water through decaying vegetable matter which gives it its peculiar colour. Should the stream, however, flow through any extent of alluvial country, or through any districts where it can gather much light-coloured sedimentary matter, it will change its aspect, and we shall have the phenomenon of alternating white and black water rivers. The Rio Branco and most of its tributaries rise in an open, rocky country, and the water there is pure and uncoloured; it must, therefore, be in the lower part of its course that it obtains the sediment that gives it so remarkably light a colour; and it is worthy of note, that all the other white-water tributaries of the Rio Negro run parallel to the Rio Branco, and, therefore, probably obtain their sediment from a continuation of the same deposits; only as they flow entirely through a forest district producing brown water, the result is not such a strikingly light tint as in the case of that river.

The Isánna, Xíe, and Guaniá or Upper Rio Negro, which all have remarkably black waters, we know flow entirely through a dense forest and granitic district, and none of them extend much beyond the parallel of 72° W. of Greenwich. The Guaviare and

the Japurá, which rise considerably W. of this line, have white waters; and the Uaupés, which also rises near them, and much further W. than all the other tributaries of the Rio Negro, has also paler waters, and in its upper course nearly white.

On ascending the Rio Negro, at about 10 miles from its mouth, we reach the city of Manao, or Barra do Rio Negro, the capital of the new province of Amazonas. At 40 miles the river divides into two branches, and from this point to the mouth of the Rio Branco, at about 200 miles up, the N. bank is never to be seen from the S. side, up which all the traffic takes place. The river is here more like an immense lake or labyrinth of islands, and is 15 or perhaps 20 miles wide. For about 70 miles below the village of Ayraõ there are high banks of clay and sandstone; below and above this are tracts of low, flooded lands, and between Ayraõ and the next village, Pedreiro, are two channels which communicate with the Solimoẽs, or Upper Amazon.

Below Ayraõ commences a hard sandstone rock; about Pedreiro it becomes highly crystalline, and a little further, opposite the Rio Branco, it changes into a true granitic rock, which, however, immediately ceases, and does not again appear until we arrive at the commencement of the great granitic district of the Upper Rio Negro. Immediately on passing the Rio Branco, islands again appear, and the opposite bank is not visible for 240 miles further, when in about 64° 20′ W. the river is clear, and its width, determined by triangulation from a measured base, is 4¼ miles. In this space we have passed the towns of Carvoéiro, Barcéllos, Cabuquéno, and Bararuá, which are all of them small, half-ruined, and almost uninhabited villages. About Carvoéiro is a labyrinth of lakes and islands in which even experienced pilots are sometimes lost. From the river Qúiuiní to Xibarú are high banks of clays and earth of various colours, with occasional inlets, lakes, and tracts of flooded lands.

All the islands, as well as the low parts of the river banks, are flooded annually for several months—generally from April to August or September, the rise of the river being from 30 to 50 feet.

In 64° 25′ W. long., the granitic formation commences, and extends without interruption up to the sources of the river and of all its tributaries. From this point there is less flooded land on the banks, and some islands are always above water. Islands still continue in great abundance up to Castanheiro. From thence to the cataracts of St. Gabriel they are more rocky, and smaller. The river averages 3 or 4 miles wide, and up towards the falls one mile.

A little below Castanheiro begin the isolated granite peaks, which are thence plentiful all up the river. The Serra de Jacamí

is the first of any size—a group of isolated, conical, granite hills, 500 or 600 feet high. About 20 miles below S. Gabriel are the Serras de Curicuriarí, which must be nearly 3000 feet high, and are the most lofty in the whole district, though the Serras de Cababurís, near the sources of the river Cababurís are perhaps nearly equal to them.

The cataracts of the Rio Negro extend in length about 20 miles, and are a series of rapids, where the river flows among islands and vast masses of granite rock, forming falls, eddies, and whirlpools, which greatly obstruct navigation. They may be descended in a few hours with a skilful pilot, but a laden canoe often takes a week to ascend them, and at some seasons more; and then with great peril both to life and property.

Above the falls the river keeps an average width of about $\frac{3}{4}$ mile to S. Carlos, the first town in the Republic of Venezuela. Above the Cassiquiare the Rio Negro takes the name of the Guainiá, and gets narrower and more shallow, varying from $\frac{1}{4}$ to $\frac{1}{2}$ a mile wide up to Maróa, the last village on the river. Above this it winds about, turning to the W., and has its sources certainly to the eastward of the meridian of 71° W. longitude, and probably near that of 70°.

The Uaupés is the largest tributary of the Rio Negro above the falls, and is perhaps larger than the Rio Negro itself; and by some is supposed to be the principal stream. We ascend it for about 130 miles in smooth water, when we come to the first group of cataracts, just above the village of St. Jeronymo. There are three falls, and they are much more furious and dangerous than those of the Rio Negro, the river being confined in a very narrow channel, and in the wet season rushing down with incredible fury. Up to this point the Uaupés is generally more than a mile wide. Above these falls we have about 50 miles more of smooth water, when with the next fall begins a series of cataracts extending for 180 miles further up the river. They are placed in four principal groups, and there are 50 of them which have native names. Some of these are mere rapids, others foaming cataracts, and others again real falls of 10 or 15 feet perpendicular height. Above these, the river is quite unknown. One more great fall, the Jurupari Caxoeira, exists, at least 100 miles further up; and above this again traders have ascended for 12 or 15 days, and report a great river with little current, with whiter water, and with trees, birds, and fishes, which assimilate it to the Upper Amazon.

The mean temperature of the water of the Rio Negro in its lower part, in the month of September, was, at 6 A.M., 85° 4′; at 2 P.M., 86° 5′; and at 6 P.M., 86° 4′; giving very nearly 86° as the mean temperature for the month, which is one of the hottest in the year. The mean temperature of the air for the same period

was, at 6 A.M., 76°; and at 2 P.M., 92° 5′. It is probable that at no time would the temperature of the water in the lower part of the Rio Negro be less than 80°.

The rise of country in the valley of the Rio Negro is remarkably slight. Humboldt gives the height of St. Carlos as 812 feet above the sea; but I have reason to believe it is much less.

Observations of the boiling point of water made at the mouth of the Rio Negro, and at different points up to near St. Carlos, gave me a rise of about 300 feet. The height of the mouth of the Rio Negro cannot be more than 200 feet, and probably not more than 150, judging from the height of Tabatinga, 1000 miles higher up the river, given by Martins as 620 feet; and from the fact of the influence of the tides being felt at Obydos, more than half-way from the ocean to the mouth of the Rio Negro.

We should, therefore, have 400 to 500 feet for the height of St. Carlos, which I cannot but think is not far from the truth. It is to be observed that Humboldt mentions *air* having got into his barometer-tube, which rendered refilling necessary, and of course destroyed the trustworthiness of the instrument.

It is a remarkable fact, that the pressure of the atmosphere at the mouth of the Rio Negro, as observed by the boiling-point of water, and by an aneroid, in the possession of my friend Mr. Spruce, was greater than at Pará at the level of the sea, giving a negative result for the altitude. It, therefore, seems probable that there is a difference of atmospheric pressure in the interior of South America independent of altitude.

Having unfortunately broken my thermometers, I had no means of ascertaining the height I reached on the Uaupés; but from an estimate of the depth of the falls, I do not think my farthest point could be more than 1000 feet above the sea-level.

The whole of the country through which the Rio Negro and Uaupés flow is one unbroken forest, which also extends over every one of the countless islands which are found in every part of its course. The numerous villages, whose names are marked on our maps, are little groups of mud-walled, palm-thatched cottages; and it seldom happens that more than two or three in a village are inhabited, the Indians preferring to reside in houses secluded in the forest, up the various narrow streams that everywhere abound. The articles of export of the country are chiefly salsaparilha and piassába. The latter is the material used to make the brooms now used for sweeping our streets, and is the produce of a palm found only on some of the tributaries of the Rio Negro.

The inhabitants of the banks of the main stream of the river are semi-civilized, and are nominal Christians; but most of the tributary streams, and especially the Uaupés, are inhabited by various tribes of uncivilized and unchristianized Indians.

The map which I have constructed of the Rio Negro and the Uaupés is from observations made during two ascents and descents of those rivers in the years 1850, 1851, and 1852. The only instruments I possessed were a prismatic compass, a pocket sextant, and a watch. With the former I took bearings of every point and island visible on my voyage, with sketches, embodying all the information I could obtain from the persons, well acquainted with the river, who accompanied me; and I constantly determined the variation of the needle, which was from $4\frac{3}{4}°$ to 5° E. With the sextant I was enabled to obtain a few latitudes with tolerable accuracy. The position of Barra on the Rio Negro I have taken from Lieut. Smith, who determined it on his descent of the Amazon in the year 1835. The other extreme point, S. Carlos and the mouth of the Cassiquiare, I have taken from Humboldt and Schomburgk. For my positions between these points I have had to trust to the time occupied in the passage to the various stations, which I always accurately noted both in my ascents and descents, and thus obtained a *mean* which I think will not be very far from the truth. I also thus gained experience as to the rate of travelling in canoes under different circumstances, which I have had to depend upon in determining my distances on the Uaupés, where I had no other method of ascertaining the longitude of the extreme point reached.

The map, therefore, does not pretend to any minute accuracy in general positions, but only to give an idea of the physical features of a river still very imperfectly known.

The following are the most important distances on the Rio Negro:—

From its mouth	to the falls of Saõ Gabriel	710	miles.
,, ,,	to the entrance of the Cassiquiare	900	,,
,, ,,	to its supposed source in long. 70° W.	1200	,,

XIX.—*Oceanic Currents, and their Connection with the proposed Central-America Canals.* By A. G. FINDLAY, F.R.G.S.

Read April 14, 1853.

WHILE almost every department of geographical science has of late made great advances through the exploration of zealous inquirers, one branch, that of the circulation of the waters of the earth, has remained nearly stationary. Although detached facts and numerous observations have been recorded, yet the generalisation of these data, and their reduction to a uniform system, remain nearly in the same state as when Major Rennell completed his "Investigation of the Currents of the Atlantic."

The history of currents, as a portion of geography, is compara-

tively new. Without including the knowledge of the Gulf Stream, which necessarily became known to the earliest voyagers to the West Indian settlements, the first contribution to the science was that by Major Rennell, "On the Agulhas Current," in 1778. This was succeeded, in 1793,* by his remarks on the current athwart the mouth of the English Channel, now known by his name. These memoirs contained the first elucidations of the system of oceanic circulation. It was about this period that chronometers began to be used in ships, and the means of ascertaining longitude were consequently first placed at the command of navigators; the comparatively rude astronomical instruments being quite incompetent to solve accurately this difficult problem. Without correct sea longitudes no estimate of currents can be formed. It will be observed that those elucidated by Major Rennell were on-shore currents, and the data on which they were established could be checked by land observations.

The only means of detecting currents in the open ocean is the comparison of a ship's reckoning with astronomical observation: unless the latter be good the former are worthless; and as the general drift of the water is in longitude, or from E. to W. or W. to E., the estimates are more difficult or inaccurate, as the means employed are less worthy of dependence; and it is tolerably certain that many of the older observations, perhaps many used by Rennell and others, are not trustworthy, being the scapegoat of errors of observation, leeway, bad steerage, heave of the sea, compass deviation, and many other elements which recent inquiries have enabled us to correct.

About the year 1810 Major Rennell commenced his current-charts of the Atlantic, at the suggestion of his friend, Mr. John Purdy, to whom hydrography is also largely indebted, and under whose editorship Major Rennell's work appeared in 1832. By this work, which embodied all previous knowledge, the following features were established on the then attainable data:—

Around the Cape of Good Hope the *Agulhas Current* ran strongly to the westward, following the line of soundings. It then ascended northwards along the W. coast of Africa to the Equator, whence it bore off to the W. under the name of the *Main Equatorial Current.* To the S. of the Agulhas Current a *Southern Connecting Current* set eastward across the South Atlantic into the Indian Ocean, between lat. 30° and 40° S., established chiefly on the observations of Captain (now Admiral Sir Francis) Beaufort. That all across the South Atlantic the *Drift Current* of the S.E. trade wind set on to the coast of Brazil, which, with the stronger force of the equatorial portion, ran to the southward,

* Phil. Trans., lxxxiii. (1793), p. 182, and cv. (1815), p. 182.

forming the *Brazil Current*, which was intersected by the outfall of the Rio de la Plata. The *Main Equatorial Current* proceeded on to Cape San Roque, and then strongly towards the West Indies, while a portion, or the *North-west Equatorial Stream*, ran slowly to the N.W., which current he was unable satisfactorily to explain. The *Equatorial Stream*, entering the Caribbean Sea, passed between Cuba and Yucatan, entered the Mexican Gulf, and, raising its level, emerged in the well-known *Gulf Stream*. This famous current, after a course of 3000 miles, gradually weakened in velocity, was finally lost, about the Azores, in the *Sargasso* or *Weedy Sea*.

It will be observed that this arrangement makes all the streams set *into* this space on the parallel of about 30°. Proceeding farther N. we find that the '*Thwart Channel Current* (or Rennell's Current) was attributed to the continuance of westerly winds propelling the waters into the Bay of Biscay, which thence ran strongly out to N.W. To the N.W. the Arctic Current, bearing icebergs, met with and joined the Gulf Stream near the Grand Banks, and the *North Atlantic Current*, a very weak stream, between Labrador and Britain, setting eastward, was supposed to be the accumulation of the Arctic and Equatorial waters. This "Head of the Atlantic" found an outlet in the *North African and Guinea Current*, a stream setting southwards between the Azores, Africa, and Spain, which, however, S. of Cape Roxo, was very undefined, and thence, setting eastward along the coast of Guinea—as exemplified by Colonel Sabine—to Fernando Po, where it met with the *South Atlantic Current*. Indulgence is requested for this recapitulation of what is well known; but in applying this system to the opposite hemisphere, we are enabled to supply some of the deficiencies in this.

Such was the state of our knowledge, as Rennell left it to us. It will be seen that there are several difficulties to be encountered. In the first place, the waters constantly setting *into* the Sargasso Sea could not be reconciled with theory. The origin and continuance of the *Guinea Current* are anomalous, and the direction and termination of the *Arctic Current* are not satisfactorily traced. Commencing from the N., we find that the *Arctic Current*, setting southwards along the E. face of Labrador and Newfoundland, turns along the American coast in soundings *against* the course of the Gulf Stream, and is probably quite stopped by the projection of Cape Hatteras. This very singular current was first properly explained by Mr. W. C. Redfield, in 1838.* Its other features have been elicited by the operations connected with the United States' Coast Survey. It appears that the Gulf Stream closes in

* Remarks on the United States Expl. Exped., Am. Phil. Soc. 1843.

with the land at Cape Hatteras, and in its progress to the N.N.E. maintains on its *inner* side a nearly perpendicular wall of warm water in contact with the cold Arctic current flowing southward.* This fact of the non-blending of the warm tropical with the cold Arctic waters in juxtaposition, as is evidenced farther to the north-eastward, in passing the Newfoundland Banks, gives great weight to the suggestion made by Mr. Redfield, that the Arctic current really passes *under* the Gulf Stream, as manifested by the ice-bergs which are brought into its warm waters, and then left when the stream becomes too deep for their former transport to affect them.

Another feature of the Gulf Stream is elicited by the observations of Commanders G. M. and R. Bache, Davis, and Lee, U.S.N., that off Cape Hatteras there is a DOUBLE *gulf stream*, or rather that there is an easterly and parallel branch to the main stream.†

Of the origin of this bifurcation, the following suggestion is offered. That portion of the Equatorial Current which enters the Caribbean Sea passes out through the Strait of Florida, in the well-known current; but that portion, embracing an extent of eight to nine degrees of latitude to the northward of this, would pass northward of Porto Rico, strike the Bahamas, and, being thence deflected northwards, will run parallel to the main stream, and thus cause the double stream in question.

In this part of the ocean there are some singular phenomena in the currents, not manifest on the surface, which brings us to an important section of the subject—that of deep-seated or *submarine* currents.

In the early history of the development of currents, only those were dealt with or suspected which were *superficial* and evident from their effect on a ship's course; later inquiries have penetrated the surface, and developed new features. Among other experiments on this point, those by Lieut. J. C. Walsh, U.S.N., made in May, 1850, are very interesting, and bear upon the circulation of this part of the ocean.‡ A logship of the usual form, but with a quadrantal arc of at least 4 feet, was heavily loaded in order to make it sink upright, and attached to a line of 126 fathoms. This line was attached to a barrega to float, and this to the usual log-line. The surface-current being ascertained, the apparatus was sunk, and was drifted in the direction, and with the velocity of the current, at the depth of 126 fathoms. The "Taney" being nearly midway between Bermuda and Porto

* Report of Prof. A. D. Bache, Superintendent U. S. Coast Survey, to the Senate, 1848, p. 41.

† Report to U. S. Senate, Nov. 1848, p. 39.

‡ Washington Herald, Nov. 9, 1850.

Rico, on four consecutive days these trials were made, as shown on the diagram exhibited—the *red* arrows in the direction and proportionate length to the surface-current, and the *blue* arrows to those of the submarine current. Referring this to the chart, it will be seen that these indicate a sort of eddy, in which waters from each direction are by turns dominant.

Rennell has presumed that the Gulf Stream ceased to exist as an independent current in the vicinity of the Azores,* and that it is here lost in the Sargasso Sea, which he makes to extend meridionally from lat. 40° to 20°, in long. 40° W. But although some exceptions may be found among the drifts of the Azore Islands, yet the charts of Rennell, analogy, and many other and later observations, will demonstrate that its onward movement does not rest here. It may, perhaps, lose its characteristics as a *weed-bearing* stream, but a portion of it is propelled perhaps by the westerly winds towards the Bay of Biscay, and hence, forming the *temporary Rennell's current* farther northward, reaches the western coast of Ireland, and, by its comparatively high temperature, and the prevailing winds passing over it, causes the climate of this country to be a marked contrast to that of Labrador on the opposite side of the Atlantic—an advantage which some have supposed to be threatened by the intended Central American Isthmus Canal, which would let the Gulf Stream out into the Pacific. This amenity of climate is perhaps still more remarkable in the corn-growing coasts of Norway, as compared with the ice-bound shores of Greenland on the same parallel.† Still farther northward we have evidence of this warm current in the comparative amenity of the climate of the North Cape of Europe, and it is fair to infer that a considerable portion of heated water, which *can* only be derived from the Gulf Stream, passes on to the *polar basin* south-eastward of the southern Arctic drift. A remarkable similarity between this portion of the Atlantic and the part at the head of the N. Pacific is pointed out in Dove's recent work, "Verbreitung der Wärme."

As stated above, the Gulf Stream does not stop at the Azores; the portion which is not diverted to the N.E., passes S.E. towards Madeira, and striking on the shores of Marocco, has obtained for that coast a sad notoriety from the numerous shipwrecks caused by its unsuspected influence. In thus tracing the continuity of the Gulf Stream, enhanced in volume by the masses of surface water obeying the direction of the prevalent westerly winds, we

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* Investigation, p. 27.

† Dr. Shaw has just informed me that a warm stream, coming from the S., runs along the W. coast of Iceland. *See* a paper by Captain C. Irminger of the Danish Navy on "Havets Strömninger" in the "Archiv for Sövaesenet." Copenhagen, 1853.

obtain a very satisfactory cause for the North African current, whose origin and termination do not appear to have been well defined by Rennell. By him it is made to follow the *whole* W. coast of Africa to the Bight of Biafra as the *Guinea* current; but any mode of reasoning we may adopt would direct us to the fact, that *before* arriving at the Cape Verdes, it would trend off to the S.S.W. and S.W., the direction of the trade-winds in this part. From multiplied observation, we find that such is the fact; and, moreover, we are informed by the Baron Roussin, that the usual currents are completely changed on passing Cape Roxo. This portion of the Atlantic is considered by Rennell as a critical point, both in respect of winds and currents, the former having a periodicity similar to the monsoons of the Indian Ocean.

Particular attention is requested to this portion, because it is one of the objects of this paper to point out an origin, not hitherto suspected, for this *Guinea* current, and which is still more manifest in a *corresponding current in the Pacific, which has an important bearing on the projected Central American Canal.*

The Guinea current is a *portion of the Equatorial Stream itself* here reflected, and coming from the westward, between lats. 5° and 10° N., from about the meridian of 28° or 30° W. It is, in fact, a WARM *current*, the North African current being comparatively COLD, there being a variation of about 10° Fahr. in the temperature of the ocean N. and S. of Cape Verde. In support of this, the charts and work of Rennell, the remarks of Horsburgh, and of many other instances, may be cited.

The main body of the *North African Current* turns to the S.S.W. and S.W., and then to the W., joining the Equatorial Stream; and the circulation is thus *around* the Sea of Sargasso—thus named from the *fucus natans* or gulf weed, a berry-bearing seaweed, so called by the Portuguese from "sargaçao," wild grapes—which lies on the parallel of 30°, almost across the Atlantic, the weed being found in all that space, and which is only affected by those partial drifts caused by the varying winds passing over it.

The circulation of the surface waters of the North Atlantic around this central space seems to be thus satisfactorily explained; and also the increase of waters brought into it by the *Arctic Current* is compensated for by the outlet *along the Norwegian coast.* A somewhat analogous process is going on in the South Atlantic. The waters circulate southward and eastward on the western side, with a high abnormal temperature, in the parallel of 30°; but the arrangement of land and ocean here allows the slow *cold* antarctic drift to flow northward and eastward with a less manifest effect than is observed in the northern polar current; nevertheless, it transports icebergs nearly as high as the latitude of the Cape of Good Hope.

In treating of the currents of the Pacific, we enter upon a comparatively new subject—one upon which little has been written, and that little certainly not satisfactory, nor confirmed by more extended observations.

Previous to detailing the phenomena of its currents, it may be asserted that the waters of the Pacific do not appear to move with that velocity nor apparent regularity that they do in the North Atlantic. Perhaps this may arise from the want of more extended and combined observations; or it is probable that the greater mass of waters, uninterrupted by land, opposes collectively a greater resistance to the action of the winds, which in themselves also appear to be less regular, and which are believed to be here the chief agent in the formation of surface currents.

Commencing from the southwards, we find the northward drift from the antarctic regions, at least permanent during the southern spring, August to October, transporting icebergs into a warmer latitude. We have no extended data or observations by which its velocity, exact duration, or direction can be estimated, which is more to be regretted, as it is a part of the ocean which probably offers some great advantages for the homeward track of vessels from Australia.

This current appears to come down to lat. 33° or 34°, with a velocity of 10 to 35 miles per day, and is analogous to the *Southern Connecting Current* in the Atlantic; but from the greater projection of the American continent it does not terminate in the same way, but, as has been demonstrated by Duperrey, strikes the coast of Patagonia or Chile, in an easterly direction about the parallel of Chiloe. This *cold* stream now divides into N. and S.—the southern branch forming the *Cape Horn Current*, the existence of which was once questioned, but which has been thoroughly established by the specific observations of the lamented Capt. Henry Foster.* Subsequent experiments have been remarkably uniform in their indications of this easterly set round the Cape, and carrying the drift-wood, &c., of Tierra del Fuego far beyond the Falkland Islands.

The other branch of this cold antarctic current is remarkable, and was first fully described by Humboldt in the autumn of 1802,† though its effects were known to the Spaniards soon after their conquest, as they used to, and still continue to cool their drinking vessels in its frigid waters in the Bay of Callao. Peru is also indebted to it for a cooler climate than its geographical position and natural character would otherwise accord to it. The remarkable difference in the ocean temperature on each side of South

* Voyage of the Chanticleer, App. vol. ii. pp. 268-273.
† Berghaus, Physikalischer Atlas.

America is well exemplified in the diagram of the voyage of the 'La Vénus' frigate.

This mighty current is not a mere superficial movement, for it has been demonstrated by M. de Tessan to be above 973 fathoms deep in one portion of its course. In its progress N. it of course gradually acquires heat, but at Callao it is 14° Fahr. below the normal temperature. Still farther to the N., at Payta and Cape Blanco, it is 10° and 12° beneath the heat of the adjacent currents. Its western limit is not well-defined; but it appears, in some portions of its course, gradually to merge into the warmer waters of the adjacent ocean.

A counter current sets at times *inside* this stream, as is very usually the case in other parts of the world; here it was first noticed by Mr. Lartigue in the 'La Clorinde' in 1822-3.*

The Peruvian, or *Humboldt's Current*, as it has been termed, follows the direction of the coast as far as Cape Blanco, where it assumes a new direction, bearing off to the N.W. and W.N.W. towards, and S. of, the Galápagos. Hereabout the system of currents is most remarkable, and has a most important bearing upon the primary object of this paper.

The cold Peruvian Current, it has been said, is totally deflected at Cape Blanco.† This is not strictly and at all times the case. It sometimes sets round the coast to the northward, to the E. of the Isla del Rey, in the Bay of Panamá, and affords great facilities for working up to that anchorage. At other times and during strong N. winds this current is reversed. After passing Cape Blanco it sets over towards the Galápagos, and causes here some singular effects. There seems to be a constant struggle between these cold and the very warm tropical waters which set into this space. Colnett mentions some remarkable veins of current near this Archipelago, the edges of which abounded with animal life,‡ and hereabout was the greatest whaling-station in the Pacific. Captain FitzRoy says that in October, 1837, when the 'Beagle' was here, on one side of Albemarle Island the surface-water was found to be 80° Fahr., and on the other side it was less than 60°§ —a surprising difference in the Pacific, where the variations of temperature are usually within narrow limits. The low temperature of this current has one remarkable effect here, in the absence of all coral reefs around the Galápagos, as shown by Mr. Dana, as might be expected from its position. The waters are too cold for the zoophytes.‖

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* Description de la Côte du Pérou, 1827, p. 20.
† Berghaus, Länder und Volkerkunde, vol. i. p. 587.
‡ Voyage to the South Seas, pp. 45-6.
§ Voyages of the Adventure and Beagle, vol. ii. p. 505.
‖ Narrative of the U. S. Exploring Expedition, vol. v. p. 471.

Having brought the antarctic waters up to the equator, they must hence be considered as forming a portion of that *great westerly movement* of the ocean *within the tropics*, known as the *Great Equatorial Current.*

In its physical relations the Pacific does not bear the same aspect as the Atlantic. The widely different arrangement of the land, caused by the easterly projection of the South American continent, so far confines the revolving action of the currents to the northern portion of that ocean, and makes the Gulf Stream the chief current. In the Pacific, on the contrary, the great breadth of ocean is left unimpeded by land, and a much greater mass of water must be set in motion to become evident as an independent current. If it can be proved that the surface action of the sea is due to the force and action of the wind, we can the more readily understand how that the currents will not be so strongly marked as in the Atlantic—a fact more evident when it is remembered that the regular trade-winds are far from being as constant in the Pacific, especially in its western portion, as they appear to be in the Atlantic. In some portions these winds partake of the character of the monsoons. In the North Pacific especially there appears to be a thermal system *apart* from any connection with the adjacent portion. The currents in the Atlantic attain their maximum velocity and heat in the western portion. In the Pacific it is on the eastern side they are most marked, from the reason, probably, that the winds have not sufficient force and regularity to cause that steady movement in the western portion, which are so evident on the opposite side of the continent, whence we find many anomalies difficult to be accounted for at present.

Resuming the actual currents—the *Great Equatorial Stream*, or the southern branch of it, has its initial impulse from the Peruvian Current. It follows the general direction of the trade-winds, or to the N. of W.; and its southern limit, beyond the influence of the continent, is at lat. 26° S. The Peruvian Current, however, does not extend its influence to nearly this parallel, as M. de Tessan's observations* make its S. limits in long. 107° 50′ W. at 9° 20′ S. To the S. and S.E. of this the westerly drift appears to be by no means constant, for neither Wilkes nor Lütke found any current between the American coast and the meridian of Tahiti. It is even stated that they flow in an opposite direction. and Berghaus has denominated an easterly set in lat. 21° to 26° S. the *Mentor's Counter Current*, from having been found by that ship October, 1823. This certainly is curious, if constant; but it may be only a partial drift, consequent upon some change in the direc-

* Voyage autour du Monde, &c., tome ix. p. 347.

tion of the wind. A current cannot be established by a single observation. Neither the observations of Kotzebue, La Pérouse, nor Lütke, confirm the existence of this current.

Whatever individual exceptions may be found as to the general set of the waters in the South Pacific, there can be no doubt that they obey the same laws as in other portions of the ocean, less evident in its southern portion, for Captain Beechey's experience in the 'Blossom' fixed the mean velocity at 9 miles per day on its southern border, and between 18° S. and 4° N., at 16·5 miles per day.

In the vicinity of the Archipelagoes, on the souther portion of this current, there are many difficulties. Their regularity seems to be greatly impeded; and, as in the case of the trade-winds, they seem at times, and without sufficient apparent cause, to set directly opposite to what may be considered as the normal direction. Among the Low Archipelago this is manifest at times, though it sets usually to the westward, at a mean of from 5 to 25 miles per day. The Society Islands have some remarkable variations in this respect, but it was shown by Captain Cook, in his first voyage, that the trade-wind cannot be considered constant here to the S. of lat. 20° S., and that S.W. gales frequently prevail to the S. of this, causing the current and swell to set on to the leeward side of the islands. This S.W. swell is almost constant at the Tonga group. To the same origin we may attribute the very singular circumstance stated by Wilkes, that a continual current to the EAST of about 12 miles a-day exists among the islands of the Feejee group. This he attributes to the existence of cold, submarine currents. The same authority also states that, on the S. side of the Samoa or Navigator's group, the current generally prevails to the *eastward*, and to the westward on the N. side.* From the very high temperature of the ocean found in this part by the American expedition, there appears to be some peculiarity in the currents. Still farther westward, both Carteret and D'Entrecasteaux found a strong current to the westward at Santa Cruz Islands. At the Salomon Islands the current runs *eastward* during the period of the S.W. monsoon, or September to March; at other seasons it runs to the westward. The current, which has been called *Rossel's Drift* by Berghaus, sets strongly to the N.W., off the New Hebrides and New Caledonia. Off the N. coast of Papua the current, as far as known, runs permanently and strongly to the westward. D'Urville found it 58 miles in 48 hours.† There does not appear to be a corresponding set to westward beyond this; indeed,

* Narrative, &c., vol. v. p. 472.
† Voyage de l'Astrolabe, vol. iv. p. 557.

to the northward of the tropic, as far as Torres Strait, there does not appear to be any current.

The *Australian Current* is an exact equivalent to the Brazil Current in the Atlantic. A portion of the South Equatorial Current, S. of New Caledonia, is turned to the W.S.W., towards the Australian coast, down which it flows to southward, a warm stream, of the velocity of one or two miles an hour, and having, as is very usual, a counter current close in shore. This warm stream becomes very strong at the southern part of Australia, and thence bears more to the E. Lieutenant Jefferies, whose remarks do not entirely accord with those of the excellent Flinders, says that the current runs to southward in summer, and is reversed during the remainder of the year.* This current, which, on a minor scale, resembles the Gulf Stream, appears to circulate around the space between New Zealand and Australia, the whole of which space is maintained at a high abnormal temperature, in which there are no distinct currents, and in the still waters of which the food of the whale is, or has been, abundant, and forms the prolific "Middle Ground" of the New Zealand and Australian whalers.

There is one other current here which has not been connected with any other system: it is a warm drift, *to the S. of Van Diemen's Land*, mentioned by M. de Tessan as having been passed in La Vénus. It is 8° or 7° Fahr. above the surrounding waters.† It is perhaps the equivalent of the Southern Connecting Current of the Atlantic, and coming from the Indian Ocean.

The *Northern Equatorial Current* has, like the southern portion, many and considerable variations in its steadiness or constancy. Its northern limit is placed by Duperrey, at a mean, in lat. 24° N.

It has been argued by M. Babinet, upon the basis of Duperrey's observations, that, in the circulation of oceanic waters, their greatest force or velocity is at their outer limits: this force gradually diminishing within the area, leaving the central space not acted on by the circulatory movement, and which area would thus be, theoretically, of a higher temperature if polar streams should not add their cooling influence. This fact is well exemplified in the Atlantic Gulf Stream, and its perpendicular outward face, and the still eddy of the Sargasso Sea. In this North Equatorial Current, also, we find the greatest strength near the southern limits; and it may be doubted whether Duperrey's limit of 24° N. be not too high, as it is stated that there is not any very distinct current at the Sandwich Islands in 20° N. by Wilkes; but then this navigator lost the trades in 19° N.; and the valuable

* Flinders' Voyage, vol. ii. pp. 282-286.

† Voyage de la Vénus, partie physique, vol. iv. p. 350.

series of observations by Dr. Rooke demonstrate that the trades do prevail here, especially from April to October.*

The North Equatorial Current does not receive such a well-defined current at its eastern extreme as the Peruvian, which recommences the southern branch, and there is a paucity of recorded observations respecting the temperature and set of the ocean between the Mexican coast and 130° W.; but it is very probable that the warm waters of the Equatorial Counter Current, setting easterly *into the Bight of the American Isthmus*, find an outlet to the northward, along the Mexican coast, for M. de Tessan found a very warm stream setting along the coast near Acapulco.

Respecting the currents around the Sandwich Islands, of course a few detached observations, such as we have at command, will not establish any systematic arrangement, but one fact will bear with great weight on it. The island of Atauai derives its name, according to Ellis, from "to light upon," or "to dry in the sun," which, the late king stated, arose either from its long droughts, or from the large pieces of timber washed on its shores. This drift of timber on its *N.E.* side is not uncommon, and Vancouver saw a noble canoe, 61½ feet long, formed out of a single *pine*-tree, which had been drifted on to the E. end of Atauai, without shake or bruise. There can be little doubt that this tree, and others also, came from the W. coast of America, indicating the set of currents presently alluded to.

Our remarks as to the further progress of the North Equatorial Current to the westward need be but few. On its southern border its velocity is considerable: Kotzebue was drifted by it beyond his control, through the Marshall Islands. At the Marianas the currents are subject to great variations, according to the observations of Freycinet and Golownin, rendering it more than probable that the westerly monsoon, which is felt here from June to October, may cause a reversion of the usual current. But it is certain that it predominates to the northward and westward beyond them. Similar remarks to those offered on the southern branch of the Equatorial Stream, between New Caledonia and Torres Strait, may be applied to the space between the Marianas and the Philippines; but the circulation of the waters is clearly manifest, as it runs strongly to the northward, on the eastern face of the last-named islands. We have thus brought the Great Central Drift of the Pacific from its eastern to its western limits; and although not many new facts are brought to bear on the subject, yet the indulgence of the Society is craved in this endeavour to give a connected view of the general phenomena of the Pacific at the present period of their greatly increasing importance.

* Voyage de la Vénus, partie physique, vol. iv, pp. 452-4.

Hitherto published accounts of the Pacific have appeared to be very vague and unsatisfactory, and the attempt is made to place them on some better footing—to assimilate it to that on which the Atlantic currents are established. And it is here confidently stated that some very important branches of the subject have been entirely overlooked, or only slightly touched upon.

Two currents at least, of immense magnitude, and of the greatest importance in the future commerce of the Pacific, have not hitherto appeared on physical charts nor descriptions, and are placed *for the first time* on the chart before you. The first is a great belt of water, lying under the zone of equatorial calms between the trade-winds, which extends across the entire breadth of the Pacific. The data upon which this may be established will be cited presently, and is here named the *Equatorial Counter Current*. The second is a gulf stream of the Pacific, hinted at by M. de Tessan in 1837-44,* as existing in the central portion of the North Pacific, but which will be traced here to the coast of Japan, and thence named the *Japanese Current*, from the analogous relation to Florida and the Gulf Stream.

The *Japanese Current* is, like the Gulf Stream, a continuation of the Equatorial Drift. By a reference to the chart it will be seen that the Philippine Islands, which lie between the same parallels as the West India Islands, unlike them, offer an entire barrier to the main strength of the western drift. Were it not for this, or if a similar arrangement existed, we might expect that the coasts of Cochin China and China itself would present the same features as the S. and W. coasts of the United States, and that a very strong current would emerge between Formosa and the main. But the waters being diverted to the northward, run very strongly past the Babuyan Islands towards the coast of Japan. There is no doubt but that the changing effect of the monsoons greatly affects the set of the currents in this part in different seasons, but of the main drift there appears to be no doubt. The first evidence we shall offer is the *Japanese charts themselves*. On all of them, as shown by Von Siebold and Krusenstern, between Fatsisio and the S. part of Nippon, S. of the capital Jedo, an *easterly* current is marked, called the *Kuro-Siwo Stream*, or, as Krusenstern calls it, Kourosegawa, or the Current of the Black Gulf. Although its dimensions are here small—not more than 15 miles broad (between these islands)—it is stated that in "winter and spring it is difficult to navigate, but in summer and autumn vessels can pass it." This notice from such authority is important in this initial portion of its *easterly* set on the coast. On the eastern side of the Japan Islands the current is

* Voyage de la Vénus, partie physique, vol. iv. p. 348.

very strong. Captain King, who accompanied Cook, states that the 'Resolution' was set at least *four miles an hour* to the N.E. by N. in long. 141° and lat. 35° 43′; and, according to his observations, the current was 250 miles broad off this part of the Japanese coast.* Admiral Krusenstern was also set 2 miles an hour to E.N.E., at 70 leagues from land, in the parallels of 36° to 35½°. When the 'Nadiejeda' discovered the coast of Japan in lat. 31°, and particularly the southern part of the island of Sikokf, the current ran to N.E. 3¼ miles per hour.† A correspondent of the Chinese Repository (vol. xii.) states that he found the current to run 79 miles in 24 hours to N.N.E. off Jeddo.‡ Captain Broughton was on the E. coast of Japan during the months of November and July, and was constantly in a current which bore to the N.E. at 2 miles an hour. These authorities will suffice to show that the current here is nearly constant, and of a force comparable to the Gulf Stream. When it reaches the parallel of 40° N. we have a remarkable evidence of its existence. It is well known that the banks of Newfoundland are proverbial for their dense fogs. This arises, not from the fact of their being shoal water, but from the warm Gulf Stream transporting tropical heat into a frigid climate near them. The Japanese Current does this also. The whole of the coasts of Jesso, the Kurile Islands, and Kamtschatka are subject to dense fogs. Captain Beechey, on his route to Behring Strait, in June, 1826, entered these fogs in lat. 39°, in long. 163°, and their S. margin also in 39° N., in long. 155° E., in June, 1827. A warm current reaches the shores of Kamtschatka. M. de Tessan points this out, and attributes the mildness of the climate of the S.E. face of the peninsula, and its comparative freedom from ice in the bays and inlets, to the warm current he encountered in 'La Vénus.'§ It has a similar effect in forming the marked contrast between the inclement western shores of Japan and the much milder temperature of the eastern side. The circumstance of the wreck of a Japanese junk at the S. end of Kamtschatka in 1726 may be cited also in evidence.‖ The wrecks of Japanese junks are also recognised on the shore on the S. extremity of Kodiack. A Japanese junk reached, and anchored at Oahu in the Sandwich Islands, after dreadful suffering, in December, 1832, having been the sport of currents and winds.¶ A Japanese junk was wrecked near Cape Flattery, in Oregon, in 1833, as related by Washington Irving.

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* Cook's Last Voyage, vol. iii. pp. 404-5.
† Mémoires Hydrographiques, partie i., Introd. p. xx.
‡ *See* Chinese Commercial Guide, Canton, 1848, p. 118.
§ Voyage autour du Monde, vol. ii. pp. 37-40.
‖ Müller, p. 8.
¶ Hawaiian Spectator, vol. i. p. 296, quoted by Sir Edw. Belcher.

Captain Du Petit Thouars, in 'La Vénus,' in October, 1837, found an enormous difference in the temperature of the water between 42° and 45° N., in long. 156° to 164° W., amounting to 13° Fahr., in the course of three or four days. In long. 164° E. he found this sudden change to occur in lat. 40° or 41° N.* These last are positive evidences of tropical waters reaching this latitude, and apparently their heat is greater than that of the Atlantic Gulf Stream in the same parallel. The incidents of the Japanese junks are links in the chain where direct evidence is wanting; for it must be noticed that this part of the Pacific is almost a *mare incognitum;* but few passages have been made, or observations recorded, as to crossing its northern part.

Now, although there is no continued series of observations on this very important stream, yet, by taking it up in different portions of its course, and applying the same reasoning as in the phenomena of the North Atlantic in the same parallels, it may be confidently affirmed that ships passing from China towards Oregon, or California, or the western coasts of America, would find every advantage in pursuing a higher northern track than has been usual. In addition to its being a nearer approximation to the Great Circle, or shortest route, which, from San Francisco to China, takes up to 48° 5′, the winds will be probably found more favourable than in a lower latitude; and the consideration of this subject has a very important bearing upon the Central American Canals.

In connecting this stream with the area of circulation in the North Pacific there is little difficulty. The American Exploring Expedition found the current S.E. and southward strongly on the parallel of the Columbia River, and as far to the westward as 143° W. Farther S. the same currents were observed in the latitudes 30° to 35° N., as far as 128° W. The Dutch brig of war 'Koerier' also fell in with these S.S.E. currents in October, 1839, in lat. 37° N., long. 132° W., and carried them down to the tropic.† The observations of M. de Tessan would place the eastern limit of the warm water in about 127° W., off San Francisco.

Connecting these facts with that of the drift-wood floated, more than probably from the American coast, over to the Sandwich Islands, the circuit of the Pacific is made; and on the parallel of 30°, in the axis of revolution, we find the favourite fishing-ground of the whalers. Wilkes states that vast quantities of janthina, the soft mollusc of which is a food of the whale, were found on the verge of the trade, in 26° N. and 168° W.; and again, when in

* Voyage de la Vénus, vol. ix. p. 348.
† Verhandelingen en Berigten door Tindal en Swart, 1852, No. i. p. 95.

30° N., in 180°, an immense collection of anatifa, another mollusc, was found lying in a line bearing W.S.W. and E.S.E., indicating the effect of current.* We do not find any notice of a similar production to the *fucus natans*, the place of which these mollusca evidently supply.

A portion of this area has been noticed as a vortex by Fleurieu, from the voyage of Marchand in 'La Solide;' but this voyage is not satisfactory for establishing currents.

Respecting the drift of the waters on the N.W. coast of America, above Sitka, it is stated that they circulate to the northward and westward as far as Prince William Sound, on the shores of which vast quantities of débris are found.† West of this, it sets to the southward, strongly at times to the eastward, of Kodiack. Whether this be only a shore current, which so usually is the reverse of that in the offing, or not, we have no means of determining absolutely. If not, it does not form any part of the circulation with the Japanese current; but temperature is one of the most important evidences of the origin of currents which so strongly influence climate; and, according to the valuable temperature-charts in Dove's "Verbreitung der Wärme," 1852, there is a remarkable coincidence, or rather exact similarity, between the normal and abnormal temperatures of the head of this great bay, and that of Norway, which lie on the same isothermal line, and in every month almost entirely coincide with each other, notwithstanding the difference of latitude—a similarity we must attribute to similar origins, the "Gulf Stream" in each ocean.

On the coast, between Monterey and the Columbia river, the current sets with great regularity, about half a knot per hour, to the southward, from March to October; in the opposite season it is variable.‡ Off the coast of Lower California, the current still bears to the southward, and there is frequently or usually a very strong outset from the Gulf of California. According to Capt. Worth, R.N., the currents off the coast of Central America are variable, *but almost always to the S.E.*—sometimes rather strong; but then there is at times a strong counter current setting close in shore, which affords the only facility for ships to work their way to the northward.

Having shown that the Peruvian Current sets its cold waters towards the Bay of Panamá, and that the currents down the coast of North America also set into the same bay, we have now to show that there is another and very extensive current also setting towards the same point.

The *Equatorial* COUNTER *Current*, which has been thus denomi-

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* Narrative, &c., vol. v. p. 109.
† Lütke, Voyage du Séniavine.
‡ Lieuts. M'Arthur and Bartlett, U. S. N., 1850.

nated from its relation to the great Equatorial Drift, might perhaps be properly named the "*Equatorial Current*," and the opposing streams on either side called the "*Tropical Streams*."

This current is an EASTERLY stream, setting with a considerable velocity between the parallels of 4° or 5° to 10° N. lat. In one portion of its course only has it found its way into charts, and this from the observations of the Prussian ships, Mentor and Princess Louise, published by Berghaus.

Commencing with the extreme W., Krusenstern says, "During the S.W. monsoon, ships returning from China and proceeding by the Pacific Ocean towards the Strait of Ganem (at the W. end of Papua), do not generally go farther to the E. than the Pellew Islands; but if they do not pay great attention to this current they will be usually carried several degrees to the *E*." * This is a current between the equator and 6° N., frequently having a velocity of 20 leagues in 24 hours. In this part it is found farther S. than in the eastern portion, probably from the different relation of land and water, as in the Guinea Current.

Duperrey found this *E.* current in longitudes 137° and 148° E., between the equator and 8½° N., and also between 2° and 6° N., at 7° to 10° E. of Ualan. Lütke also had the current E. 13 miles per day, in lat. 3° N., when near Ualan. To the W. of this, between 5½° and 7° N., for 3 weeks in January, there was a constant easterly current of 8·3 miles per day, as a mean.† Capts. Hunter and Wilson also found it *E.*, to the southward of the Caroline Archipelago. In July, 1833, it was found to run to the E. 2 or 3 knots an hour, near the equator, for 15 days, in about longitude 175° E., and this during a fresh easterly wind.‡ In the Gilbert Archipelago, large trunks of trees are drifted on to the *W.* sides of the islands in S.W. winds, together with large lumps of resin similar to those found in the soil of New Zealand, which must all be transported by currents.§ In the longitudes of 167° to 150° W., with some exceptions, the ships of the United States' Exploring squadron found it setting a little N. of E., in Sept. to Nov., 1839. Capt. Scott, R.N., of H.M.S. Samarang, on Sept. 16, 1840, found it set 50 miles per day, N. 33° E., in lat. 6° 47′, long. 163° 13′ W. Capt. Beechey found it set N.N.E. 15 to 23 miles a day between the equator and 4° N., that is, to the S. of our present limits, on the meridian of 150° W. Among the most important series of observations recorded of the Pacific are those taken in the French frigate, La Vénus, under Capt. (the present Admiral) Du Petit Thouars, which have been frequently quoted

* Mémoires Hydrographiques, part i. p. xv.
† Voyage du Séniavine, partie nautique, p. 186.
‡ Naut. Mag. 1843, p. 5.
§ Narrative U. S. Exploring Exped. vol. v. p. 105.

here. The temperature of the air and ocean were taken every hour throughout the voyage. They crossed the track in question in June, 1838, about the meridian of 135° W. The observations show a considerable increase in the temperature, as might be expected, if our inferences be good; but, singular to say, there is no *direction* of the current recorded;* perhaps it was considered, if the set was *easterly*, that the observations were defective from their anomaly, and the transition from the steady westerly currents observed before and afterwards.

Between the meridians of 125° and 132° W., we have the authority of the several voyages made in the Prussian ships, Mentor and Princess Louise, for establishing this as an independent current, these observations extending it, in some cases, to 11° N., but not southward of 6°. Admiral Lütke also experienced the same on the meridian of 129° W., in May, 1827. In December, 1849, the Dutch brig of war, Koerier, crossed this track in long. 112° W., and found the *easterly* current commence in lat. 9¾° N., and with a velocity of from 25 to 35 miles per day; but on arriving at its southern limit, in lat. 4° N., she was drifted no less than 330 *miles in* 5 *consecutive days* to the N. by W., and northerly currents continued as far as lat. 1° S.† Capt. Sir Edward Belcher, in the Sulphur, at Clipperton Island, lat. 10° 17′ N., long. 109° 10′ W., says that the island was covered with sea-birds, which had been noticed in great numbers during the previous week at least 500 miles to the eastward. From this an *easterly* current may be inferred, as these birds generally keep its stream or tail course.‡

Capt. Beechey, on crossing from Acapulco southwards, in long. 99°, found an easterly current of 8 miles per day between that port and 8° N.; S. of this they flowed to westward. When Vancouver crossed on this track, in December, 1794, he had a westerly current of 30 miles a day, but between lat. 9° 27′ N. and Cocos Island the set was half a knot to southward; after this strong ripplings and great agitation, denoting a conflict of currents; and on making Cocos Island there was a strong current of 2½ knots setting to the *E.* and *N.E.* Colnett found it setting strongly to the W.

Now, upon referring to the chart upon which most of these observations are placed—and it will be noticed that they are all, or almost all, drawn from recognized authorities,—the limits of this *new* current are in general well defined within the latitudes we have named, 5° and 10° N., and that this and other currents have a tendency TOWARD that one locality now looked upon with

* Voyage de la Vénus, partie physique, vol. iv.
† Verhandelingen, &c., door Tindal en Swart, 1852, pt. i. p. 97.
‡ Voyage of the Sulphur, vol. i. p. 256.

so much interest. It cannot be supposed, however, that they always set *into* the bight without some regular outlet; but this does not appear to have been detected as a SURFACE current, with which alone the navigator has to deal. The currents about Cocos Island are very violent, and perhaps uncertain, but of their *eastern* tendency, at times, there is no question. The only direction for an outlet which now suggests itself is indicated by the very warm current encountered by La Vénus, off Acapulco.

The current system which thus centres in the Bay of Panamá, by which term is here meant that great indentation of the American coast, of which Panamá Bay is the head, is most peculiar, and, as far as is known, unexampled; for the Bight of Biafra, although somewhat similar, is not entirely so. Their anomaly and difficulty have been rendered very evident by the history of voyages in this portion of the Pacific, and many sad tales of suffering may be told of ships leaving Panamá without a proper knowledge of the best route to be pursued. As a case in point may be mentioned that of "the barque Emily, of London, which sailed from Panamá for San Francisco, March 7th, 1852, and after being out ninety-five days, put into San Blas with 19 of the passengers *dead from starvation.* The remaining passengers were then transferred to the Archibald Gracie, and were sixty-five days more on their passage to San Francisco, during which 18 more of these unfortunate people died: the suffering endured is almost beyond description." Yet the route pursued, we believe, was that stated to be a proper one to Captain Basil Hall, by a local authority.* She steered a course which took her beyond the influence of the land-wind and shore-current, by which alone she could have made progress.

In endeavouring to trace these mighty operations to their origin, to connect effect with cause, we encounter several difficulties at the outset. But little is known of the powers of absorption of heat in the water of the open ocean; we do not know even its density accurately, and all experiments have probably placed the maximum of this too high. Colonel Sabine states its maximum density, as arising from temperature, at 42° Fahr., and Sir James Ross at 39·5°. This last observer places the points where the temperature is the same (39·5°) from the surface to the bottom of the ocean, in a mean latitude of 56° 26′ in the southern hemisphere. This is assumed from a series of experiments commenced on January 3, 1842, in lat. 66° 34′ S., when the temperature *increased* from 36° at the surface to 39·5° at 945 fathoms. Many experiments might be cited which show different results from this, at least on this side of the

* Extracts from a Journal, &c., pt. ii., Appendix i., No. xii.

equator; but of its accuracy there can be no doubt. Nearer to the pole than this zone there will be colder water above this stratum of 39·5°, and toward the equator it will be warmer, so that we find this maximum density under the equator at the depth of 1200 fathoms. Sir Henry de la Beche estimates that this bed of cooler water forms an inclination towards the *pole* of 1 in 1723, and towards the *equator* of 1 in 1136. "So small an angle, with a change of temperature so gradual, could scarcely produce a lateral movement in the mass of ocean waters of geographical importance." To this source we cannot, therefore, attribute any origin of currents, which, besides, are chiefly in the opposite plane to meridional action which this would induce.

Respecting the maximum density of water, Erman places sea-water at a temperature of 25°, Dr. Marcet at 22°, Colonel Sabine at 42°, and Sir James Ross at 39·5°; but at whatever point it is fixed hereafter, one thing at present is certain, that we can sink a sounding-weight to an enormous depth, and obtain submarine temperatures at a stratum which, if the density increased with the depth, would place it beyond possibility; but there is one difficulty in assuming that the *depth* is accurately measured by the length of line run out.

We have before shown, incontestably, that there are sub-surface streams of a very different nature to those evident by their effect on a ship. Supposing a sounding-line encountered one or more such streams, and it is tolerably certain that they will do so, the impact of a current on the sounding-line (supposing it to be 1-10th of an inch in diameter, the sectional area of 1000 fathoms is 50 square feet) must swerve the line greatly from the perpendicular; and should the weight reach the bottom, it will carry the line off the reel with *double the velocity of the current*, so that the sounding by wire, 5700 fathoms, by Lieutenant Walsh, U.S.N., or the still greater depth, 7706 fathoms, attained, or supposed to be attained, by Captain Denham,* is open to much doubt.

Temperatures supposed to be gained at great depths cannot be said to be absolutely accurate, for the depth actually reached must remain unknown; the pressure of the water may affect the bulbs of the thermometers—a point endeavoured to be rectified by the spiral of two metals employed by the Americans.

These remarks are made to show that, *as yet*, we know little or nothing of what is going on at great depths beneath the surface; and as the chief practical interest is in what is encountered on the surface, we will confine our consideration to that.

Of the action of the moon, or the progress of the tidal wave in the Pacific, our acquaintance is as yet very imperfect, notwith-

* Nautical Magazine, Feb. 1853, pp. 98-100.

standing the light thrown upon the subject by Dr. Whewell; but where the currents are strongest the tidal action is usually the weakest. To this source, then, we cannot attribute all action. Heat, which in the case of the atmosphere is the undoubted cause of circulation, will not answer all the requirements. On reference to the diagrams before you, it will be seen that the air and surface-water maintain a very great equality throughout their course; but then the fluids are so different, the one moving with a velocity so many times greater than the other, that their relative differences to the source and acquirement of heat are greatly assimilated.

The action of the prevalent winds is the chief and efficient source of surface-current action, and a few words on them will be excused. A diagram taken from Lieutenant Maury's recent work will illustrate it, though it does not greatly differ from what Dampier gave as a result of his own experience, or from the previous conclusions of Halley, Young, and others.

The earth in its revolution, having the sun constantly vertical over some portion of the space within the tropics, becomes heated in this zone; and the atmosphere becoming thus specifically lighter, rises and gives place to cooler air rushing below from the regions N. and S. of the tropics; but as the equatorial portions move most swiftly, these are deficient in velocity, and drag as it were on the surface; and from being simply N. and S. winds they become N.E. and S.E. trade-winds. Blowing in this direction they must meet somewhere, and they form a belt of calms or variable winds, of a mean breadth of 6° of latitude. This heated air then rises, and passes off in the exactly opposite direction; that which comes in from N.E. passes off to S.W., and above the trade-winds blowing beneath at right angles to this course. This fact is proved by the passage of volcanic dust, in opposition to the trade-winds. Passing N. and S. it again cools; and having reached the limits of the tropical zone, it redescends in what are here called the calms of Cancer and Capricorn. This warm wind then blows toward the poles, gradually parting with its heat and moisture; till at last reaching the pole quite dried, and at a minimum temperature, it, by its accumulation, rises, and returns towards the tropics to undergo the same process of circulation. Supposing the earth to be of a uniform surface as to the distribution of land and water, these belts of calms and winds would be symmetrical on either side of the equator; but the proportion of land to water in the northern hemisphere is 100 to 154, while in the southern hemisphere it is 100 to 628, according to Professor Rigaud. Yet all the countries in S. latitude are remarkable for the dryness of their climate, and it can be demonstrated that the evaporation of the S. is deposited in the northern

hemisphere. From this unequal distribution of land and its effects we have the phenomenon of that line of junction of the trade-winds to the NORTH of the equator (in a mean between 8° and 2° N. lat.), varying with the progress of the sun in the ecliptic, but always characterised in its axis by an enormous deposition of rain; and hence it is known to seamen as "the rains," and is the great barrier to the passage of ships across the line, from its calms and uncertain winds. It will be seen that *the proposed great canal* will lie in this belt, and that during the northern summer months it will be deluged with rain.

There will be no great difficulty in assigning a great effect to the action of wind on the ocean water. The following may be advanced. Its well-known effects in retarding or advancing, increasing or decreasing, the tidal wave, will be one argument;—the storm-wave, which, in a region very distant from its origin, is felt in the form of those terrific "rollers" which set in on the islands of the open ocean; the effect of wind in the formation and direction of waves in the English Channel is well known; the whole of the débris of the coasts being driven to N.W., and accumulating near the Straits of Dover, &c., by the predominant S.W. winds; the accumulation of waves on each other, in the triple or other numerical ratio, superinduced by separate action on previously-formed waves, &c.

That they have an onward progress cannot be denied, it is believed, although this is still, to some extent, an open question; but if a wave can strike a square foot of surface with a force of above 6000 lbs., as has been found by the dynamometer at the Skerryvore Lighthouse, a force equal in weight to a column of granite 60 feet high, or to raise a spout to the height of 130 or 150 feet, as at the Mauritius Souffleur, or spray to the height of 300 or 400 feet, as on the W. coast of Scotland—it must have some onward movement. Without bringing in M. Emy's theory of the *flôt du fond*, which time will not admit of, it may be safely asserted that the wind has sufficient force to cause all known *surface* current action.

The trade-winds, then, setting constantly in one direction, must drive the waters before them to the opposite side of the ocean, causing an accumulation, or head, which theoretically would be, and is practically found to be, of a higher temperature. The question of level is a delicate one; but it is fair to infer that such inevitably must be the case, and the velocity of the Gulf Stream is a great evidence of this, notwithstanding that it runs up-hill as to its base, but could not do so as to surface. If the same action is to be found in the Pacific, and the waters here are to be found accumulating on the western side, and only drawn in on the eastern side from the abstraction, the Pacific level would be several feet

lower than the Atlantic, consequently, the canal would have a strong current or a cataract to the westward. But engineering operations have demonstrated that the levels are sensibly the same, and we have therefore to infer that the uniformity is maintained by the presence of that counter-current which has still to be accounted for.

The trade-winds, then, setting on to a zone to the N. of the equator, with more or less tendency towards the N. or S. of E., forcing the waters in a similar direction, they must meet somewhere, and cause an accumulation.

Major Rennell says "the drift-current is the mere effect of a constant or very prevalent wind on the surface-water, impelling it to leeward until it meets with some obstacle which stops it, and occasions an accumulation and consequent stream of current. It matters not whether the obstacle be land, banks, or a *stream of current already formed.*" This equatorial tendency of the drift, it is contended, is the source of this current, which, using the head of water previously formed as a fulcrum, is compelled to revert its direction when not affected by the winds, that is, in the belt of equatorial calms. This is also the true origin of the Guinea Current in the Atlantic, which the meeting of the North African and Equatorial Currents prevents passing to westward.

The form of the main currents, that of a parabola or ellipsis on the axis of 30° N. or S., is similar to that of cyclones, and is also indicative of similar origin.

Panamá and Darien are thus placed in a very *critical* position with respect to those means of navigation most usually employed. The adoption of screw-propellers or other auxiliaries must vastly enhance the utility of the canal. But a correct knowledge of the neighbouring winds and currents is a most important desideratum in the establishment of any commercial navigation in connection with this great undertaking.

Much misapprehension as to the distances to be saved by opening this route prevails in the world. The southern part of New Zealand is at our antipodes; therefore, a straight line drawn on the globe, that is a great circle, will intersect both places, and be of the same length if directed to any point of the compass.

The use of Mercator's projection has drawn attention from the real properties of the sphere, which, it is pleasing to see, are beginning to be felt as imperative, and will be still more so in extended Pacific navigation.

Thus the shortest line between Panamá and Shanghae in China leads into latitude 64° 43′ N., and starts from Panamá about N.N.W., passing between St. Lawrence Island and Behring Strait, while by the chart the apparently shortest or straight line is about W. $\frac{3}{4}$ N. from one place to the other; yet this apparently direct

course is 8982 miles in length, the great circle course being 8089½ miles, or just 900 miles less, and is removed from it in one part 2405 miles. Now, if a line of 8982 miles be laid on the other side of this shortest line, it will pass through the whole of North America from S.W. to N.E., and, passing between the North Cape of Europe and Spitzbergen in lat. 75° 29′, long. 24° 17½′ E., across Siberia and then to Shanghae.

This extreme case is cited to draw attention from the Mercator's chart, and the incorrect notions it inculcates.

Supposing a ship could save 500 miles on this route, which she may very readily do, and in the 8400 miles she encounters a current of only 12 miles per day, by using the shortest and best route she may be assisted to the extent of 1200 miles in the single passage, a distance she may lose if these are not attended to.

National Observatory, Washington, May 10, 1853.

Sir—The clipper ship Sovereign of the Seas, McKay, has made such an extraordinary run, that I beg to make it the subject matter of an official report. It is due to builders, owners, and masters, as well as to navigation, that such an achievement should be made known.

This ship is one of the glorious fleet of a "thousand sail" that is voluntarily engaged in making observations for the wind and current charts. She it is, it will be recollected, who, taking them for her guide, made the extraordinary run of 103 days from New York to San Francisco, both crossing the equator in the Pacific, and arriving in port on the day predicted.

Returning from the Sandwich Islands to New York in the remarkably short run of 82 days, she passed through a part of the "Great South Sea," which has been seldom traversed by traders—at least I have the records of none such.

Little or nothing, except what conjecture suggested, was known as to the winds in this part of the ocean. The results of my investigations elsewhere, with regard to winds and the circulation of the atmosphere, had enabled me to announce as a theoretical deduction, that the winds in the "variables" of the South Pacific would probably be found to prevail from the westward with a trade-wind-like regularity.

Between the parallels of 45° and 55° S. from the meridian of the Cape of Good Hope eastward, around to that of Cape Horn, there is no land or other disturbing agent to intercept the wind in its regular circuits; here the winds would be found blowing from the west with greater force than from the east in the trade-wind region, and giving rise to that long rolling swell peculiar to those regions of the Pacific, they would enable ships steering east to make the most remarkable runs that have ever been accomplished under canvas.

The Sovereign of the Seas has afforded the most beautiful illustration as to the correctness of these theoretical deductions.

Leaving Oahu for New York, viâ Cape Horn, 13th February last, she stood to the southward through the belts, both of the N.E. and the S.E. trades, making a course good on the average through them, a little to the W. of S. She finally got clear of them March 6th, after crossing the parallel of 45° S., upon the meridian of 164° W.

The 8th and 9th she was in the horse latitude weather of the southern hemisphere. So far, her run had been good, but there was nothing remarkable in it.

Having crossed the parallel of 48° S., she found herself, on the 10th, fairly within the trade-like W. winds of the Southern Ocean; and here commenced a succession of the most extraordinary days' runs that have ever been linked together across the ocean.

From March 9th to March 31st, from the parallel of 48° S. in the Pacific, to 35° in the Atlantic, during an interval of 22 days, that ship made 29° of latitude, and 126° of longitude. Her shortest day's run during the interval, determined by calculation (not by log), being 150 knots. The wind, all this time, is not recorded once with easting in it; it was steady and fresh from the westward.

In these 22 days, that ship made 5391 nautical miles. But that you may the more conveniently contrast her performance with that of railroad cars and river steamers, I will quote her in statute miles.

Here, then, is a ship under canvas, and with the winds alone as a propelling power, and with a crew, too, so short, the captain informs me, that she was but half manned, accomplishing, in 22 days, the enormous run of 6245 miles (one-fourth the distance round the earth), and making the daily average of 283 statute miles and nine-tenths (283·9). During eleven of these days consecutive, her daily average was 354 statute miles; and during four days, also consecutively, she averaged as high as 398¾ statute miles.

From noon of one to the noon of the next day, the greatest distance made was 362 knots, or 419 miles, and the greatest rate reported by the captain is 18 knots, or 21 statute miles the hour. This is pretty fair railroad speed.

The greatest distance ever before performed from noon to noon on the ocean, was 374 knots (433¼ statute miles), by the clipper ship Flying Cloud, in her celebrated passage of 89 days and 21 hours, to San Francisco, in 1851, and which yet stands unequalled. I say from noon to noon, because from noon to noon was not, with either of these ships, the exact measure of 24 hours. The Flying Cloud was going to the northward and westward, and on the day of her great run she made 4° 46′ of longitude—which, in time, is 19 minutes 4 seconds—that is, her noon to noon for that day, 24 hours, 19 minutes, 4 seconds. On the other hand, the Sovereign of the Seas was steering to the westward, and on the day of her great run, she made 8° 44′ of longitude, which, in time, is 34 minutes 56 seconds—that is, her noon to noon for that day was only 23 hours, 25 minutes, 4 seconds long. Thus the Flying Cloud's run in 24 hours, 19 minutes, 4 seconds, was 433¼ statute miles, and the other 419 statute miles in 23 hours, 25 minutes, 4 seconds.

Reducing these runs each to the performance *pro ratâ*, according to log, for 24 hours, we have for the former ship 427·5 against 437·6 by the latter—that is, the best 24 consecutive hours run by the Sovereign of the Seas exceed the best consecutive 24 hours of the Flying Cloud only by the one-tenth part of a mile.

These two ships are certainly *par nobile*, but the great day's performance of each does not prove the Sovereign of the Seas to be a faster ship than the Flying Cloud.

The Sovereign of the Seas had in her favour that long, rolling swell from the westward, that is peculiar to high southern latitudes, and which helped mightily to heave her along. All seamen who have doubled Cape Horn know what it is. I need not describe it.

It is true that the Flying Cloud on her great day had, during the latter part, strong gales and high seas running; still those high seas were not like that long, rolling Cape Horn swell that comes from the westward with such a heaving force, and which had been chasing the Sovereign of the Seas steadily for ten days.

On the other hand, it may be urged in favour of the latter, that she was short-handed, with foretopmast disabled, and jury topgallant mast. Her abstract log, it should also be mentioned, says nothing as to the force of the wind, the heave of the sea, or the sails set, while that of the Flying Cloud is quite full upon these points.

Though I am unwilling, therefore, to decide against the Flying Cloud as to the greatest day's run ever made, it is clear that her competitor has borne off the palm as to the length of time for which she has kept up her great speed. Her log stops May 3rd, latitude 33°, 15′ N., 432 nautical miles in a straight line from Sandy Hook.

Taking it therefore for the 79 days for which she gives it, and stating the distance by straight line from her place at noon of one day to the noon of the next, it appears that her daily average was 222·7 statute miles, making the whole distance sailed during the interval to be 17,597 statute miles, which gives for canvas the remarkable achievement of accomplishing a distance more than two-thirds of that

which it requires to encircle the earth, at the rate of 9 miles and upwards the hour, for 1896 consecutive hours.

As I write this, the abstract of another ship the Comet, E. C. Gardner, from San Francisco to New York, is received. She, too, has made the passage in 83·3 days, sailing during the interval 17,496 statute miles, and averaging 210 miles a day. She, however, except merely by doubling Cape Horn, did run through the region of the trade-like winds and heaving swells of the South Pacific, which favoured the Sovereign of the Seas to such an extent; and therefore no fair comparison can be made as to the relative sailing qualities of these two ships.

There is another circumstance, however, connected with this voyage of the Sovereign of the Seas, which is worthy of attention, for it is significant, and a fact illustrative of the revolutions in the way of business which are being quietly wrought by the time-saving devices of the age. This splendid ship, after unloading her cargo in California, was sent to glean after our whalemen, and she came home with oil gathered from them at the Sandwich Islands.

This adventurous class of our fellow-citizens resort there in such numbers that the fees annually paid by the government for the relief of the sick and disabled seamen there, amount to upwards of 50,000 dollars.

Now, if the Pacific Railway were built, the thousands of American seamen, and the fleets of American whale ships, that annually resort to those islands for refreshment and repairs, would resort to California. There they would be in their own country; the oil would probably be sent home on railway, instead of by clipper ship, and all the advantage of refitting so many ships, of treating and recruiting so many men, would inure to the benefit of our own-citizens. Respectfully,

(Signed) M. F. Maury,
Lieutenant U. S. Navy.

XX.—*Chusan, with a Survey Map of the Island.* By Sir J. F. Davis, Bart., F.R.S., F.R.G.S.

Read June 13, 1853.

The importance of this island was sufficiently demonstrated by its capture on two successive occasions by a British force, and its retention (on the last) for a period of four years, as a guarantee for the fulfilment of the stipulations of the treaty with China. If any additional considerations could augment the importance of Chusan, it would be the vicinity of the position to Japan, and its intervening between the mainland of China and that other nation which once actually occupied it, and which is fast becoming an object of interest and speculation to the civilized world. Whatever may be the result of the pending American expedition to Japan, it is certain that the new current of adventure, setting westward across the Pacific, must find Japan, with Chusan, the first outposts of the Asiatic Continent in that direction; and Christian states must inevitably be involved in relations, amicable or otherwise, with those hitherto secluded regions. The object of this paper is to illustrate a Map of Chusan, completed by actual survey during our last occupation of the island, when Brigadier (now Sir Colin) Campbell had the command, and to add such other details as could be collected from various sources (chiefly through Dr. Gutzlaff) in several visits to the spot. The last was

in 1846, on my surrendering Chusan to the Chinese government, according to the provisions of the treaty of Nanking.

The Chusan group appears at first to have been occupied by fishermen. The islands were in the seventh century incorporated with China, although the control at first exercised was of a precarious nature. Tradition states, that an emperor of the Soong dynasty, who held his court at Hâng-chow during the Mongol invasion, fled to Chusan for shelter. During the Ming, or next Chinese dynasty, the Japanese, then the most commercial nation of Eastern Asia, made Chusan their entrepôt, and carried on a lucrative trade. Having afterwards gone to war, on account of the illtreatment of their countrymen by the Chinese, they took possession of the island and kept it for many years. This forms a singular parallel, as far as it goes, with our own case. Chusan subsequently reverted to the *Ming*, or Chinese dynasty,* whose representatives, long after the Manchow Tartars had taken possession of China, sought refuge there and defended themselves. But the Manchows at length became masters of Chusan and surrounded Tinghae, the capital, with a wall. They made it, moreover, a naval station, such as it was found by our force in 1840.

The latitude of Jos-house hill, to the right of the landing-place, near Tinghae, is 30° 0′ 24″ N., and its longitude 122° 6′ 24″ E. of Greenwich. The island lies from N.W. to S.E., with a circumference of $51\frac{1}{4}$ miles, the extreme length being 20, the extreme breadth 10, and the least breadth 6 miles. The hills which traverse the whole island with their various spurs, render the divisions of the territory natural ones; and the valleys between them contain the small towns or villages with their population, which all belonged to the Hien of Tinghae, dependent in its turn on the superior district, or Foo, of Ningpo. The town of Tinghae stands about half a mile from the beach, of irregular form, nearest approaching a pentagon; in length about 1200 yards from N. to S., and 1000 in average breadth. The surrounding wall is nearly 3 miles in circuit, with four gates, each defended by an outer gate having a side approach. The ditch on the outside of the wall is interrupted on the N.W. side by a spur from a neighbouring hill, which projects into the town, and forms an easy access to an attacking force on that side. This hill constituted the head-quarters of the Cameronian regiment in 1840. On the arrival of the British force in that year, the population of Tinghae numbered from 25,000 to 30,000.

Upon the S. coast of the island, the plains consist mainly of

* The new aspirant has assumed the title of "*How Ming*," or "Latter Ming" dynasty.

alluvial tracts gained from the sea, and still on the increase. There are in some places threefold dykes, showing the gradual encroachment of human industry upon the deep. On the northern coast the case is different; there the sea, unchecked by those numerous islands which to the S. act as natural break-waters, beats with great violence on the shore, urged by the prevailing N.W. winds; and the inhabitants have with incredible labour reared solid stone walls in the most exposed spots, to prevent the salt water getting into their rice-fields.

The valley in which Tinghae stands is called *Yungtung*, and is one of the most extensive in the island, being 4 miles long by 3 broad. Standing nearly on a level with the sea, and copiously irrigated by canals, it is well suited to rice cultivation. It is enclosed along the S. front by an extensive dyke. This was in 1841 considerably raised and converted into a line of batteries, which our force easily took in flank.

Proceeding westward we come to *Yen-tsang*, a valley which (as its name imports) contains extensive salt-works. It is still lower than the former, and protected by a double row of dykes. Our men-of-war generally anchored in front of this. The inland valley of *Chae-ho* opens into it, and sends a stream through it to the sea.

Further W. along the coast, and penetrating N. into the interior, is the extensive valley of Tsze-wei, richly cultivated with rice and sweet potatoes. The plain in the immediate vicinity of the sea bears traces of having been recently gained from the water, and the dykes are in some places fourfold. One was, during 1843, in actual process of construction, a proof of the confidence of the natives in their new masters. This lowland is divided by spurs from the hills; and insulated hillocks, which at some time or other were evidently islets, rise from the plain. The distance between it and the island of Kintang* (called by us during the war "Silver Island") is inconsiderable.

Chae-ho is an inland valley to the eastward (divided into Upper and Lower, or North and South Chae-ho), running parallel with the former nearly N. and S., but the smallest of the two. Its romantic scenery was an object of admiration to every one. There are considerable mountains at the sides, and the land gradually rises to the W. and N., where it terminates in some lofty and bleak elevations, the most barren as well as highest portion of the whole island.

The westernmost valley of the S. coast is *Tsinkong*, which winds W. and N., and is again subdivided by spurs from the hills. Close to it is *Tsatsoo*, called by us "Blackwall Island;"

* The nearest point of communication with the mainland of Ningpo.

and the harbour is formed by three islets, which at some points approach so near to the Tsin-kong side as to make the harbour look like a river. One very high pass leads into the Tsze-wei valley on the E., and several smaller ones join it to *Tae-sha* on the N.

The last-mentioned, or "Great Sandy" Valley, consists of three narrow and separate divisions, running between ridges of hills in a N. and N.W. direction towards the sea, opposite to the island of Chang-pih Shan. This forms the north-western extremity of Chusan, connected with Tsze-wei by a pass over the mountains, as well as with *Seaou-sha Aou*, or "Little Sandy Valley."

Seaou-sha gradually extends in breadth northward towards the sea. There is a branch of the Tsze-wei division with which it stands in immediate connexion southwards; while a long and narrow defile leads off inland to Chae-ho, through a country of barrenness.

Going now in an easterly direction round the island, we arrive at *Ma Aou*, or Horse Valley, the second large plain in the island, and an extensive tract of the most fertile soil. With the exception of the mountain road which leads to Chae-ho, the hills around this are not very high.

The narrow valley of Kan-lan runs parallel with it, and spreads towards the sea. The hills inland to the S. are lofty and sterile, but the pass leading into *Pih-tseuen* is not very high. This valley of "white springs" spreads over a considerable plain, forming the centre of the northern valleys, and lying opposite to *Yung-tung* on the S. In that direction it communicates with *Seaou-seĕ*, which consists of two verdant plains, yielding in fertility only to Pih-tseuen, and further S. with *Yung-tung* by the high *Tung-kaou* Ling, or "Pass."

Further E., along the N. coast, is *Pĕ-chen Aou*. This lies opposite to the island of Lan-sew-shan, being in some places very narrow between the hills, while in others it extends more inland. Pĕ-chen is subdivided by several passes until it reaches further eastward to *Tachen*, the easternmost of the northern plains, a district of considerable magnitude extending along the sea-shore, and running inland into several smaller valleys, which are connected with *Tung Aou*, *Leu-hwa*, *Poo Aou*, and *To Aou* to the S.

The last-named is on the south-eastern extremity of Chusan, with its harbour at *Sinkeamun*, which harbour is land-locked by the opposite islet of Lokea. Going now due W., we arrive at a mountain pass which leads into *Leu-hwa*. This consists of two large and several small valleys winding along at the foot of mountains, and opening to the W. on the extensive plains of *Tung Aou*, which is again subdivided into the *inner* and *outer*. It

contains the largest level space on the island, and towards the sea has extensive alluvial plains, well situated for the manufacture of salt, which engages the attention of the greater portion of the poorer classes.

Wooseay, consisting of several small divisions, joins it on the W., and has likewise a narrow strip towards the sea; and after crossing two small valleys, one of which is called *Yang Aou* (from the fruit peculiar to the island), and the other *Tsing Aou*, we again reach *Yungtung* and the town of Tinghae, from whence we set out.

The Map of Chusan shows the direction of the mountains, running principally across the breadth of the island. The greater part of the surface is hilly ground, in geological character generally corresponding with the adjacent group, and consisting chiefly of granite. No volcanic traces have yet been discovered, although several of the Japanese islands, at a short sailing distance, are of that class, and among them Sulphur Island has an actually burning crater.

On most of the hills there is a moderate coating of earth, which permits the growth of grass and fir-trees; and industry has improved their natural advantages to the production of sweet potatoes and other vegetables. The climate of the island, in 30° lat., is admirably suited to the vine, as are also the declivities of the hills; but the Chinese make no wine from the grape. Bamboo groves are planted, notwithstanding the comparatively high latitude. The tea-shrub grows in many places luxuriantly. An exception occurs in the highest ridges about *Seaou-sha*, *Chae-ho*, and *Ma Aou*, which are comparative barrenness, fit only for herds of goats. In some places artificial terraces have been constructed, and, as the supply of water is considerable, the earth thus retained by stone walls produces good crops of rice. The inhabitants have been very diligent in the construction of paved paths across the hills, which facilitate the communication at all seasons of the year. There are also small Budhist temples built in these passes, where the passenger is supplied with tea, the leaves of which the surrounding peasantry contribute gratuitously.

At a distance these elevations often look very wild, but on a nearer approach it is found that no soil has been lost, the smallest patches having some productive cultivation. Every poor man may choose an unoccupied spot on the hills and prepare the soil for trees or vegetables, paying little more than a nominal rent, and remaining the undisputed owner as long as he continues to cultivate it.

The ground-rent of the whole island appears to be very light. According to a return obtained by Lieut. Shadwell, of the 98th Regiment (for some time holding civil employ), there are three

rates of rent, as in the rest of China. The irrigated ground, or *Tien*, pays annually per *mow*, 110 copper coins in money, and something under 2 caltics of rice. The dry ground, or *Te*, where corn and vegetables are grown, pays 88 copper coins, and about 1½ caltics of rice. The remaining ground, called *Shan*, or hills, pays only 3 copper coins, and nothing in kind. The object of a part payment in grain may be to preserve something like an average corn-rent.

There are many small streams running from the mountains and crossing the plains into the sea, of which the largest is the Tung-keang, east of the town, which reaches the harbour close to Joshouse Hill. At high water, the native boats can ascend this only a short distance, to a place called Tung-keang Poo, where a number of merchants carry on an active trade with the neighbouring main. There is not a valley without its stream; some with boats, sluices, and bridges. Many are dry during the summer, but when the rains fall they furnish sufficient water for the canals and reservoirs. The canals in some places form a network, and furnish a supply to every rice-field. Though not constructed by persons of professed science, they prove to have been laid out on the best plan, and are examples of practical skill. It is only within the town itself of Tinghae that these canals are noxious, exhaling most offensively in summer.

During part of the winter, the canals of the lowest valleys overflow and cover the fields, though most of the roads and paths are sufficiently raised for keeping up the communication. The inundation which occurred in 1843, at the commencement of October (during our occupation), was unprecedented. The clouds seemed to come down in a mass, and the water accumulated with such rapidity that no precautions could abate its violent effects. The western part of the island exhibited a sheet of water, out of which the hills rose as islands. Immense pieces of rock were swept down by the torrents from the mountains, bridges and causeways destroyed, some of the rivulets changed their beds, while many of the most fertile fields remained covered with gravel; but on ordinary occasions, the sluices are sufficiently adapted to letting off the waters, however great the quantity. The wet and dry seasons here and at Hongkong* are reversed; in the south the winter is dry, and the flooding rains fall during summer. The difference of lat. about 8°.

As to climate, very accurate tables were kept during our long tenure of Chusan. Considering the position of the island, in 30° lat., the average temperature is remarkably low; but the influence

* This word is often written as two separate ones; but there is no better reason for writing Hong Kong than Chu San or Lon Don.

of the sea tempers both the extremes in comparison with the opposite main. In the beginning of the winter of 1841, while the snow at Ningpo fell above a foot in depth, and remained on the ground for several days, there was a mere sprinkling at Chusan. North-westerly winds prevail throughout the year, and it is only during July and August that the heat is oppressive to Europeans. In 1843 the weather was still so cold during some part of May as to render a fire comfortable. Nature revives generally about the beginning of February, when the first blossoms of the plum-tree make their appearance. The real flower season is in April and May, when the whole surface of the country is decked in the brightest colours. Cherries are ripe in May, and a great variety of vegetables brought to market, including peas and beans. In June the grain harvest commences, and most of the blossoms diminish. A new cultivation takes place this month. Crops of rice, with millet, coriander and other seeds are then sown, and rain falls to July. In September the weather is generally cool and dry, and the temperature delightful in October, during which the last of the rice harvest is brought in. The sweet potatoes are ripe in September. The first hoarfrost is seen in November, and during December it often freezes severely; but the ice does not remain so long as on the main. Most of the trees being deciduous, the island looks bleak during the winter. The fan-palm, however, grows in the open plains, and even the plantain in sheltered nooks; but this last, though it blossoms, brings no fruit to maturity. Opinions were at first very unfavourable as to the healthiness of the climate, and the terrible mortality among the troops in 1840 seemed to justify the worst that could be formed. Certainly the rice-fields, which are nothing but marshes, alternately flooded and dry, might lead to the conclusion that the exhalations must be unfavourable to European constitutions. But in 1840, much of the ill effect might be ascribed to the influence of the war. The fever was then prevalent among the natives, and carried off large numbers of them. Subsequent experience, from 1842 to 1846, when the island was peaceably restored, convinced the most doubtful that the climate is really salubrious, and that the mortality among the troops in 1840 was caused chiefly by the want of wholesome provisions and good lodging, joined to the effects of *samshoo*, the deleterious Chinese spirit. Fevers occasionally prevail during the summer months, but they seldom resist the use of quinine. The Sepoy troops from India suffered from the cold of the winter.

In its productions Chusan does not materially differ from the adjacent mainland of Ningpo. The sleek and small cattle, and the buffaloes, larger than those in the south, are used exclusively for the plough, and never slaughtered for the use of the Chinese,

so near to the head-quarters of Budhism in the neighbouring island of Pooto. The small cultivators do not keep a bullock, but there are men who hire them out for the value of about 8*d.* a day. There are no grazing pastures, the cattle being driven to the mountains, and receiving very little fodder besides. The soil being very adhesive, ploughing is a difficult process; but, notwithstanding the smallness of the cattle, they are very efficient, and more than one is seldom or never seen in a plough. Horses are not used for agricultural purposes, and the Chinese government does not allow the common people to have them in their possession. There are, however, asses of a very strong description, and a mule is occasionally met with. These are used exclusively for riding; while all burthens are either transported in boats or on men's backs. A small species of goat is killed for its meat; but they give very little milk, an article of which no Chinese ever makes any use whatever. During the British occupation many flocks of Tartar sheep were brought over from the main, and throve extremely well; but they were killed entirely for the consumption of the English. Pigs are not so numerous as on the main, and are sometimes imported from thence. The dog is of the common Chinese breed, like the Esquimaux variety; and occasionally a very diminutive Japanese dog is met with. The island is too well peopled to leave much range for wild animals; a few small deer seem to be the chief.

Fowls are of the largest description, in fact of the Ningpo breed. Ducks are reared in immense quantities by the peasantry. There are large establishments where the young are artificially hatched, and sold at the rate of forty ducklings for a dollar. Even geese are hatched in a similar manner. A few pheasants and woodcocks were found by English sportsmen. Wild swans come during the winter in hundreds, and occupy the extensive watery flats; as also wild geese and wild ducks. Our people shot snipes in the rice stubble, but they are not disturbed by the natives. The presence of our force, and the demand for game, gradually induced the Chinese to pursue it; but the principal part comes from the main.

One of the dainties in the waters of Chusan is the yellow, or mandarin fish, which, during April, May, and June, is caught round the island in such quantities as to occupy above a thousand boats. It is a large fish, rather flat, and of a yellowish hue, and, when fresh, nearly as handsome as the gold-fish, with a dorsal fin of the same colour. When caught, it is immediately sold to merchants who are on the spot, with large boats filled with ice, in which, being carefully packed, it is taken over to the main, and thus sold all over the country. The flesh is good, and when a little seasoned with sauce, possesses an excellent flavour, highly estimated by

Chinese gourmands. This fishery forms an important branch of industry, and occupies a considerable portion of the islanders. A small species of shark, of a dark grey colour, is also caught during summer, and, being salted, is sent to other parts of China. The shallow, muddy seas in this neighbourhood abound in fish, and produce herring, mackerel, mullet, pomfret, ray, sole, sturgeon, and other varieties.

Of reptiles, a black snake is very common, and found in the fields; but, from the little heed taken by the natives, it may be supposed to be innocuous. There is another large snake that frequents houses, pursuing rats, and other vermin, with great hostility; and, as it is harmless, the natives do not discourage it. It is black on the back, with a yellowish-white belly, and grows to six or eight feet in length. The silkworm is reared by only a few families, but the position and the climate of the island would insure success in a more extensive cultivation of its produce.

Chusan does not abound in wood. This scarcity is not the fault of the soil, but owing to the thriftless habit of cutting down all the growth of the hills as it rises up. The most frequent, perhaps, is the useful tallow-tree (Stillingia), spared and cultivated on account of its produce. It is found principally on the banks of streams, where it blossoms in May, and the berries form in bunches, coming to maturity in October and November. By this time the leaves are of a beautiful red, the pods containing the seeds burst, and these seeds make their appearance coated with white tallow, and about the size of a pea. Suddenly the leaves fall off, and the trees, from the whiteness of their berries, look as if they were in blossom. The natives then cut the branches, gather the berries, boil and press them so as to make the tallow run into a fat, which, when congealed, resembles the animal tallow, but is less firm and consistent. The island produces a large quantity of this substance, especially in the north-western districts, and exports largely.

The varnish-tree, which somewhat resembles the fig, thrives also very well in Chusan. The oil or varnish extracted is inferior to that produced in Ganhoey, which may perhaps be from another plant. The natives excel in applying it to wood-work of all kinds. Their furniture, and the framework of the best buildings, are beautifully varnished; and the durability of the coating is such as to insure its superiority to all oil-painting, and other contrivances for protecting wood against the influence of climate and time. The tree might be introduced with great advantage into Europe.

The camphor-tree also flourishes at Chusan, and will grow to a large size if permitted. The natives, however, only use the wood, and do not extract the resin as they do on the main. This

tree, too, might be well introduced in Europe, being very ornamental and sufficiently hardy. A kind of elm, of which the blossoms, when dried, are used as a dye-stuff, and much esteemed by the Chinese, grows on the banks of streams. The dwarf fir and oak are as common as the full-grown trees are rare. The banian ficus is even in this latitude a beautiful tree, and, as in the interior of China, planted for religious purposes round temples and other public buildings. A slender graceful pine is cultivated for ornament; and the people show superstitious veneration for the cypress, which they plant chiefly near graves.* This peculiar sort is the *Cupressus pendula*, or "weeping cypress," brought to England by Mr. Fortune. The Chinese say that this tree soon decays, but the wood is firm and fragrant, and esteemed by their cabinet-makers.

The natives possess apricot, peach, plum, apple, and pear trees, but take no trouble to improve them; and the fruit is consequently of the most wretched description. The Loquat, and some kinds of oranges, grow well without much care. The best fruit in the island is what has been erroneously styled "arbutus," which it very closely resembles both in fruit and leaves, being at the same time quite a different tree. The Chinese call it *yangmei*, and Mr. Fortune says it is—

> "A species of Myrica, allied to the Himalayan *M. Sapida*, noticed by Frazer, Royle, and other writers. The Chinese variety, however, is much superior to the Indian. Indeed, I believe the Chinese have both, but use the Indian as a stock for grafting on. There is a very large plantation of this tree in Chusan, and the fruit was beginning to be brought to the market during my stay. The trees were bushy, round headed, and from fifteen to twenty feet in height. They were at that time loaded with dark red fruit, not unlike, at first sight, the fruit of our arbutus, although very differently formed (internally) and much larger."

It is well worth introducing in England.

> "The oil plant, *Brassisa sinensis* (Mr. Fortune observes), is in seed, and ready to be taken from the ground in the beginning of May, and there is a great demand for the oil which is pressed from its seeds. I may state that this plant is a species of cabbage, producing flower stems three or four feet high, with yellow flowers and long pods of seed like all the cabbage tribe. In April, when the fields are in bloom, the whole country seems tinged with gold, and the fragrance which fills the air, particularly after an April shower, is delightful."

He adds,—

> "The flora of Chusan, and all over the main land in this part of the province of Chĕkeang, is very different from that of the south. Almost all the species of a tropical character have entirely disappeared, and in their places we

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* "When I am dead, inter my body on the brow of some unfrequented hill, and plant the fir and the *cypress* thickly around."—Chinese drama, 'Heir in Old Age,' p. 34.

find others related to those found in temperate climates in other parts of the world."

That new and beautiful plant, the *weigelia rosea*, was first discovered, Mr. Fortune tells us, in the garden of a Chinese mandarin, near the city of Tinghae on this island. "It was loaded with its noble rose-coloured flowers, and was the admiration of all who saw it, both English and Chinese." It is fortunately quite a hardy plant, and flourishes in the open air in this country.

The tea-shrub is grown almost everywhere on the island, but treated with little care, and left almost wholly to itself. The produce is accordingly of an inferior kind. It seldom grows above four feet in height; and occurs sometimes wild among the mountains. The utmost care taken by the natives is to weed a little round the plants; and so congenial does the climate appear withal, that the plant still thrives, and produces good crops of leaves. There are, on an average, two gatherings in the year. The first commences in April, and comprises the young and finer leaves. Old and young women are then busily employed in gathering them, while the mistress of the family keeps up a slow fire under a large iron pan, into which they are thrown. When sufficiently heated, a strong man receives them into an oval basket, and kneads them with all his might in order to press out the superfluous moisture. They are then spread out on a large frame of wicker work, under which a little fire is kept up. This process is repeated after an interval, and the tea is subsequently sorted and picked, and sold to small merchants, who export it to the main, principally Soo-chow. The finest tea fetches about a quarter of a dollar (or one shilling) per catty, of $1\frac{1}{3}$ lb., and suits the Chinese; though, on account of the slightness of the firing, it is not calculated for the foreign market. Chusan exports about 30,000 dollars worth every year, besides its own consumption.

The bulk of the inhabitants give their whole time to the cultivation of rice, the *summum bonum* of every Chinese, who affects to pity those countries which do not grow it. Wherever the smallest spot can be converted into a rice-field, they are ready to abandon any other culture, though it might seem more advantageous. Notwithstanding this, however, there is not sufficient produce for the consumption of the island, and one-fourth the annual supply is brought from Tae-choo. They have the white, red, and *no-me*, or old man's rice. The first resembles Carolina rice in the largeness and whiteness of the grain. The seed is first thickly sown in a small bed in the spring. Thence it is transplanted into the field in bunches, and placed very exactly in rows. The greatest care is taken to provide an ample supply of water, with which the field is flooded; and the tread-wheels are constantly

raising water to the different levels in dry weather. Every weed is carefully pulled up, and the appearance of any is considered discreditable to the cultivator. The grain is ripe about the month of August: after being first bent down by the farmer, it is subsequently cut off, and thrashed out by beating against the inside edge of a large basket or tub, provided with raised sides to prevent the loss of the grain. Next it is dried, freed from straw and other impurities, and laid up for use. To disengage it from the husk, they pound it in large stone mortars, and then winnow it. The coarser kinds are placed in a stone mill, which is put in motion by a bullock, and a rotatory grinding separates the chaff from the grain. The crop that has been last put into the ground arrives at maturity in October, or even as late as November; but this crop, on account of the uncertainty of the weather, is liable to be spoiled before it can be gathered in. The produce varies from twenty to thirty fold.

One of the most graceful and prolific grains in Chusan is the Barbadoes millet, which grows to a great height, and is said to produce an hundred fold. Towards harvest time, when rice is getting scarce, it is made into cakes of a reddish hue, and thus constitutes the food of the people. The large thick stalks are used for fuel. There are besides two other kinds of millet, of a fine grain and very white, which are used instead of rice.

The wheat is of an inferior description. There are two different species, both of which have a low stalk, and one is unbearded. The Chusanites cultivate it like rice, transplanting it in bunches, but without the irrigation. Of the flour they make cakes and vermicelli, and use the grain extensively in distilleries. The barley is small, and ground down by the poorer classes to mix with their rice. Buckwheat is grown in small quantities on the most sterile lands, and also found wild.

The attempts to introduce our common potato succeeded in some measure; but the sweet potato grows so successfully on the brows of the hills, that it constitutes a cheap and excellent food for all. The yam and taro are grown, but the latter is small and insipid. The fields produce a variety of summer and winter beans, as well as green peas. The radishes, turnips, and carrots are very fine; but the variety of kitchen vegetables is not great. The brinjal (a species of solanum) grows in perfection, as well as cabbage, lettuce, and spinach, with cucumbers, melons, and pumpkins. There is the large *Petsae* or Peking cabbage (more like a lettuce in appearance), which is salted or pickled and eaten largely by the Chinese. Ginger, of an excellent description, is common, and the coriander seed is cultivated on ridges. The fields, to a large extent, are covered with crops of mustard, the

seeds of which are exclusively used for expressing the oil, a considerable item of export.

The cotton shrub is largely cultivated near the sea, and espepecially on lands which have been gained from the water, and still contain saline particles. Both the white and the brown, or nankeen, cotton are grown, but the latter only in small quantities. Each is of a very fine fibre, superior to what is imported from India, but also twice as dear, and by no means of so long a staple. The *yu* hemp-plant, from which grass-cloth is made, grows almost wild, and is cut down twice or even thrice a-year for the sake of the fibres. The women, however, do not work it into a texture, but merely spin it into thread, and use it for sewing, probably on account of its strength.

The only walled town in the island is the capital Tinghae. One-third of the ground-plan of this has no habitations. The level sides of the wall are encompassed by a ditch, that stops short on the hill which enters the city on the north-west. The wall is 18 feet high and 15 feet thick, and on the west and east sides nearly in ruins, notwithstanding the extensive repairs by the Chinese in 1841. The parapet remains in a very few places. The hill enclosed within the wall on the north-west side is a spur from the neighbouring ridge, and was occupied in 1840 by the 26th, or Cameronian regiment, so many of whom fell victims to disease, and were buried there. The city is traversed by canals, which are a real nuisance, without any countervailing advantage. The largest street is that which runs in a straight direction between the south and north gates; the rest are small and short—many of them mere lanes. There are four gates at the cardinal points, forming the outlets of the principal streets, and also a water-gate between the west and south gates. The buildings are mostly of an inferior description, with the exception of two temples, dedicated to ancestors, and to the guardian idol of the city. In the former is the largest representation of Budha that has been met with. A few of the richer classes have long, rambling houses, walled in within a court containing a whole series of buildings. The shops of the better traders are very showy; but the common people have mere mud hovels, or paltry dwellings put together with tiles and stones, without regard to warmth, ventilation, cleanliness, or comfort. Many of them are built in squares; and in a little space, which four Englishmen would find too narrow for an habitation, there are perhaps forty Chinese huddled together. Tinghae would not, in fact, rank with a good country-town in England. Before our occupation it had a suburb towards the sea, called *Taou-tow*, consisting of streets, some wood-yards, distilleries, and stores, all of which were levelled with the ground,

and their places supplied by barracks. Temple, or Jos-house, Hill, which commands the town and harbour, and was in 1841 so diligently fortified by the Chinese, is 800 yards from the south gate, and 122 feet high, close to the beach, with a canal on the east side. The dyke along the front of *Yungtung* valley was converted by the notorious* Yukien into a breast-work against an attack by sea, and has since been falling into decay. During our occupation a new suburb, calculated to surpass the old one in extent and solidity, gradually rose up at Tungkeang Poo, some way up the Eastern creek or canal, and houses were daily rising there.

The harbour of Chusan is formed by the island itself on the north; Trumball and Macclesfield islands on the south; Grove Island and Beacon Rock on the east; Guardhouse and Tea Island on the west. It is well landlocked, the water varying from four to eight fathoms; but the currents are strong, with not very secure holding ground: they run nine knots per hour.

The largest place next to Tinghae is the town or village of Seaousha (Little Sandy Valley), a manufacturing station, where they make agricultural implements. *Ta-chen* has also a small town, as also *Sinkea-mun* to the east, and *Tsinkong* (or Sinkong) to the west. By far the greater portion of the population lives in villages and hamlets, which are scattered all over the island, and found in the most secluded spots. The richer landholders generally assemble their tenants in a very large enclosure, where a whole clan lives together with children and children's children, and this generally constitutes a village in itself.

The people of Chusan are shorter than the Chinese on the mainland; and there is no doubt of a considerable mixture of Japanese blood ever since that people possessed the island. It is well known that the Japanese are universally of short stature. Though often strong-limbed, the Chusanites are not a fine race. Their women are particularly unattractive: owing to the habit of drawing their hair very tight, or some other cause, they lose their hair early, and become bald. The materials of dress are generally the same in both sexes. In summer they are clothed in grass-cloth (called *Hea-poo*, or summer cloth), mostly dyed blue, and some wear next to the skin a strange garment composed of a bamboo net-work; that is, small sections of bamboo (like bugles) formed with string into a species of net, which prevents the upper garments coming into contact with the body. On festive occasions they are gaily decked out with the help of embroidery. The better classes wear the fine stuffs of Hâng-chow and Soo-chow. Since the introduction of our calicoes the

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* 'China during the War, and since the Peace,' vol. i. p. 184.

cleanliness and comforts of both sexes have advanced; and this applies to the lower orders as well as the upper. In winter they wear stuffed cotton dresses, mostly of light-blue colour; a few, also, sheepskins, and the more respectable classes, furs, which, during our stay, gradually gave way to broadcloth and camlets. The lower orders dress by no means so extensively in woollen as the cheapness of our long-ells might lead one to expect; and this is the more surprising as contrasted with the considerable consumption of English cotton goods. A thick and coarse kind of Russian cloth was much in use; but of late the merchants of Ningpo, as well as the people of Chusan, seem to have preferred our manufactures, which, though thinner, are more durable, and retain their appearance longer than the Russian. The general introduction of woollens must be a work of time; but, as a proof of the growing consumption, may be mentioned the great falling off in those silk manufactures which were formerly used as either linings or covers for fur dresses, as these were worn outwards or inwards.

Few ragged persons are met with; but the thrifty housewives understand patchwork thoroughly, and the warmth and thickness of the garment increase in proportion as it is mended. The under-garments of all classes are generally in an abominable state; nor are the richest ashamed of vermin and cutaneous diseases.

All classes of people are gross feeders; and, strange to say, the only articles of food for which most of them entertain an aversion are beef, milk, and butter. This seems originally grounded in the old Budhist superstition, in regard to the flesh at least. Rice is the basis of the daily food of all, eked out among the poor with barley, sweet potatoes, and millet. They have three hot meals a-day; and even the beggar has a number of small messes with which to season his rice. The richer classes, even on common occasions, have as many as twenty small saucers before them, containing pickled fish, cockles, salted vegetables, soy, and similar condiments. The sea furnishes the largest quota in this account, and the ingenuity of the people in preparing these marine delicacies is remarkable. Whatever is highest seasoned and most pungent pleases them best. The consumption of meat is but small, as in the rest of China; and even pork, in such general use elsewhere throughout that country, is but sparingly eaten at Chusan. On the occurrence of festivals they prepare dishes which, in point of elaboration, might rival the productions of finished cooks; and it is by no means uncommon to see as many as seventy following each other in succession. Generally, however, they are very moderate in their habits. Even the use of the distilled spirit called samshoo, so general on the arrival of the British, very much declined subsequently, in consequence of

the many restrictions it became necessary to impose for the sake of the troops. The consumption of opium was very small in comparison with that at Sincapore and Hongkong.

The town of Tinghae and its suburbs had, at the commencement of 1843, about 27,500 inhabitants, including men, women, and children; a large number, considering the small extent of buildings. But even this large number, strange to say, under the government of foreign conquerors, increased towards 1846 (when the island was restored) to above 35,000. Our census did not extend to the whole island, of which the population can only be *assumed* at 200,000 besides. Notwithstanding the general fertility, and the cultivation of rice in every available nook, considerable importations of grain are required.

Dr. Gutzlaff, who was for some time civil magistrate at Chusan, reported that

"Nine-tenths of the inhabitants live from hand to mouth, upon a very miserable pittance. I have gone from cottage to cottage, from hovel to hovel, in order to satisfy myself about the means of subsistence among the majority of the labouring classes, and found it at a very low level. An artizan, who understands his work tolerably well, receives, besides his daily food, about 60 copper cash (the twentieth part of a dollar), or 2½*d*. With this he has to maintain his family; but they contrive to subsist upon such a pittance, and the reason is, that the wives understand how to eke out a trifle; and the children, almost as soon as they can walk, are taught to contribute something to the common stock. Even under such pinching poverty they are seldom heard to grumble, seeming to understand their duties better than their rights, and never looking to others for aid as long as they can move themselves. The poverty met with in the houses, accompanied by unabated cheerfulness, is a characteristic of the Chusanites.* When, after having prohibited begging in the streets, all the paupers of the island were collected, we had about seventy individuals, and these were either old, decrepit men and women, or blind and maimed people, who justly claimed our charity."

Any one in the town may carry on what business he chooses, having first served an apprenticeship, and been for some time a journeyman. In the country valleys, however, the poorer classes depend entirely upon the more prosperous landholders, and, though slavery does not exist, they have to work as hard as any slaves. There is no legal restraint; the bond is merely social, the landlord being in some measure responsible for supplying his peasantry in time of scarcity with provisions at a certain rate. There is an extraordinary restriction as to the transport of grain from one valley to another (just as there is in China, from one province to another), because it is believed that if this transport were allowed, the price in the immediate neighbourhood would rise. Owing to this absurdity, the price of rice in Chusan itself varies sometimes surprisingly in the respective districts.

The Chusanites are not fond of the sea like the people of Fokien;

* Perhaps of the Chinese in general.

but on land they resemble their own buffaloes in the patience with which they tread day after day through their inundated rice-fields. Being able to bear much fatigue, and perfectly hardened against the inclemency of the weather, they are subject to few diseases, The two that prevail most are "jungle fever" and elephantiasis. The former is at times very malignant, and carries off numbers in a short time, as was the case in 1840, partly perhaps the consequence of the war. The latter displays itself in the swollen legs of the patient, which increase in size gradually until his death; though this complaint, however incurable, does not seem much to shorten life, as many who are afflicted with it reach old age.

No male above twenty years of age remains single if he can help it, and the women are married as early as sixteen. An old unmarried woman is unknown, nor are old bachelors often met with. The advantages attending the married state, according to Chinese institutions and notions, keep up the population to a high-pressure state; but there are few families with more than four or five children. The disproportion between sons and daughters cannot be ascribed to natural causes, and it is admitted that female infanticide prevails here as in other parts of China. The females, notwithstanding their cramped feet, work very hard both at home and in their fields; but the men never oblige them to plough or perform the labour of cattle, as is the case in some parts of China.

A wedding is celebrated by all with more expense and display than any other event of life. The parent of the bride receives a certain sum of money, as soon as they agree to marry their daughter, but they at the same time furnish her *trousseau.* The men are generally too poor to have more than one wife, and the conjugal tie is pretty lasting. The wives are remarkable for their quarrelsome dispositions and passionate behaviour when once roused.

They do not attend much at home to the education of their children, beyond teaching the daughters to sew. The sons at about six years of age go to school if the parent can afford it, and pay perhaps the value of two or three dollars annually to the teacher. In those establishments of course none but the most elementary knowledge is taught. The boys learn to read the sacred books of Confucius, and to write a legible hand, and leave school as early as twelve or fourteen years of age. Those who intend to repair to the public examinations, and choose a higher walk of life, continue longer at school and subsequently read at home. When we first took possession of the island, there were two colleges wherein the youth of maturer age studied to become guaduates, but the sum total of the learning, as usual, did not go beyond explaining the classical books (those of Confucius), and writing essays. As some thirty were advanced every year to the grade of

Sew-tsae, (bachelor) there was a great deal of emulation among them. A few of the elder having obtained the rank of *Keu-jin* (licentiate), and one of them even promoted to a magistracy in Honan province, literature was held in some esteem and reputation on the island. Nevertheless the mass of the population, in consequence of their extreme poverty, can neither read nor write, and this is the more remarkable, as in most parts of China few of the male sex can be found entirely devoid of an elementary education.

The character of the population comprises the usual mixture of good and bad. It has been shown that they are a hardworking and patient race, and easily guided when once their confidence has been gained; but, like their countrymen on the mainland, they are commonly lying, thievish, and faithless. The most solemn asseverations amount to nothing, and nobody considers himself obliged to perform promises unless bound by something more cogent than a mere sense of duty. They are fond of litigation, easily awed into obedience, orderly and quiet; but of course ignorant and narrow minded, and incapable of comprehending anything beyond the range of their very limited experience. We have seen that they are patterns of contentment, cheerful bearing, and patience under difficulties; but in their social dealings they are knaves, and, whoever has the power and opportunity to do it, oppresses and takes advantage of his neighbour. During our four years' tenure of the island as conquerors, martial law found them very quiet and orderly subjects, and had little or nothing to do the whole time.

Such religion as they possess consists in the forms and rites of the grossest idolatry. In the town, and in the numerous valleys, there are abundance of temples (called by our people Jos-houses) built by subscription on nearly the same models according to their respective sizes. These serve for the varied, and somewhat inconsistent, purposes of schools, taverns, gambling-houses, and theatres. They are generally built, in the country, at some romantic or picturesque spot, in some hilly pass, or some wooded nook, and derive more of their attractions from this than from their architecture. In them are to be found a few clay images of gods or deified heroes rudely executed, and in the larger ones is a priest who subsists on alms, and rather degrades the ecclesiastical character by acting at once as tavern-keeper and waiter to the travellers or visitors. Both temples and priests belong to the Budhist religion, and the hierophants are of the lowest order of uneducated people, satisfied with a bare subsistence. All their business is to burn incense before the images, keep the lamps trimmed, and on festive occasions light up the building; or, at other times, they are working in the field; for to some of the temples a piece of land is attached as an endowment. They

exercise no influence upon the minds of the people, but are generally treated with contempt.

Altogether different from these are the preachers of the *Taou* sect, or Rationalists,* of whom there are about thirty in the town of Tinghae, and some in the country. They read sermons at burials, marriages, times of sickness, and other domestic occasions, and also exercise the office of exorcists, the Chinese being especially afraid of ghosts. The punishment of hanging was viewed by the natives at Hongkong as a comparatively indifferent matter, as long as the bodies were delivered to the relatives, to be interred with the usual ceremonies; but when the order was given that they should be buried within the precincts of the gaol, the terrors of both hanging and imprisonment were both much increased, and with salutary effect.

The priests of Taou wear no distinguishing badge, nor do they maintain celibacy, but lead a secular life among the people at large. In their professional capacity they recite in a drawling tone discourses which only the initiated can understand, and will go on for five days for a single dollar. The common people look upon them more as sorcerers than teachers.

In many houses there is a domestic shrine, where the inmates light a lamp and burn incense; but, subsequent to the occupation of the island by the English, idolatry of all kinds very much declined. Their gods had perhaps fallen into discredit since the untoward results of the war. Occasionally a procession might be seen winding its way through the streets; but only the rabble were to be found in its train. The mass of the people really live without religion, totally unmindful of anything but the supply of their physical wants. The only Sabbath in the whole twelve months is the New Year; all the rest is a round of unceasing daily toil, to those who are condemned to labour.

The occupation of nineteen in every twenty of the inhabitants is agriculture. A large portion of the soil is held by families, not individually, but according to the Chinese rule of domestic clubbing. On letting lands to the cultivators, a stipulation is made for one half of the produce in kind, and, when the harvest arrives, the corn, on being beaten out, is put into scales and thus equally divided. The cultivator pays the tax to Government, according to the nature of the land, at so much per mow, a space that will produce at the most 8 peculs of *paddy*, or rice in the husk. The farmer must provide all the means of cultivation, and holds his lease, as tenant at will, entirely at the pleasure of the owner, who seldom lets above ten mows to one farmer, generally only five, with the produce of which the latter must manage to subsist.

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* Described in 'The Chinese,' vol. ii.

Their agricultural implements are of the most simple description. The ploughshare is a piece of cast iron; the spikes of the harrow consist of knives which cut sideways. After the second rice harvest is off, they plough the fields, allowing them either to lie in large clods, or sowing a species of clover, which is used, not for feeding cattle, but as a manure. This is confirmed by the observation of Mr. Fortune, who says,—

"After the last crop of rice has been gathered in, the ground is immediately ploughed up, and prepared to receive certain hardy green crops, such as clover, the oil plant, and other varieties of the cabbage tribe. The trefoil, or clover, is sown on ridges to keep it above the level of the water, which often covers the valleys during the winter months. When I first went to Chusan and saw this plant cultivated so extensively in the fields, I was at a loss to know the use to which it was applied, for the Chinese have few cattle to feed, and these are easily supplied from the road-sides and uncultivated parts of the hills. On inquiry I found that this crop was cultivated almost exclusively for manure. The large fresh leaves of the trefoil are also picked and used as a vegetable by the natives."

Their main reliance, however, is on the most disagreeable, though perhaps the most fertile, manure so universal in China. They keep it in small water-proof tanks, and promote fermentation by throwing substances into it. They are in this respect extremely filthy, and with senses more obtuse than might be readily imagined. For peas, and some other vegetables of the pulse tribe, they use dry ashes as manure, throwing it into the drill prepared for the seed, and thus manuring the plant rather than the ground. The discovery of Liebig, that beans and peas contain *Caseine*, a substance identical with the curd of milk, has been familiar to the Chinese for centuries; and *bean-curd*, or cheese (called by them *Tow-foo*), is commonly hawked about the streets.

They transplant almost every article from a seed bed, no matter whether green vegetable, grain, or pulse, and assimilate the cultivation of nearly everything to that of rice. In the case of the sweet potato (a convolvulus), they cut off the sprouts and plant them, after having dug up the previous crop. These sprouts are an article of trade; and, to improve the quality of the potato, people from great distances on the coast of China come over to Chusan and plant whole tracts of hills, with a certain stipulation regarding the produce.*

Chusan has but few manufactures. Some weavers make up coarse stuffs of cotton from yarn which has been spun by the cottagers; but the home-made article is not sufficient to clothe more than a portion of the population. There are some forges constantly at work in *Seaou-sha* (the Little Sandy Valley) for providing

* Might we not either prevent, or greatly mitigate, the potato disease, by taking more pains in the importation of seeds from parts of the world where the complaint has not yet appeared, or climates better suited to the original nature of the plant?

agricultural implements; and the salt works on the coast, make up the total of industry apart from agriculture. Within the town of Ting-hae, during our occupation, a considerable business was carried on in the carving and varnishing work, which exists in such perfection on the opposite coast at Ningpo. Nothing can exceed the durability and neatness of furniture prepared in this manner. The greatest care is bestowed on bedsteads, or rather little tabernacles which constitute both a bed and dressing-room within themselves, and on which a profusion of carving and inlay-work is lavished. One of these obtained a prize at our Great Exhibition.

Previous to our occupation of the island, a great number of junks which traded between the N. and S. touched at Chusan, anchoring in the harbour of Ting-hae, where the suburbs formed a depôt for merchandise. The presence of our shipping seemed to discourage this resort; but Sinkeamun to the eastward continued to be a place of rendezvous for a great number of vessels, chiefly fishing craft, which ranged at large among the group of islands, and along the embouchure of the Keang, manned principally by Fokien sailors. These adventures are partly carried on with the capital of the island; and some Fokien firms, who traded in company with Chusan merchants, were established in Ting-hae. Thus the most necessary article in China next to rice, that is, fish, was provided for the adjacent main from the Chusan group, whose shallow seas and landlocked roadsteads are unusually favourable to fishing. The other principal exports were coarse black tea, cotton, vegetable tallow, sweet potatoes, and some wheat. The larger junks were driven away by our capture of the island, but the smaller craft seemed to increase. They came from Wunchow, Taechow, Shihpoo, Seang-shan, Ningpo, Shaouhing, Hângchow, and Chapoo, bringing the produce of their respective districts, and principally rice, as well as Sycee silver; in return for which they bought our cotton manufactures, opium, a few woollens, and some Strait's produce. But the European trade at Chusan never approached the anticipations of many sanguine speculators. The neighbourhood of Shanghae and Ningpo was alone enough to attract and engross the main part at those large marts, especially the former. Compared, however, with what existed previous to our arrival, the trade was active, and many of the native traders of Tinghae became comparatively opulent; a result which they could very little have anticipated, from what they must have been accustomed originally to regard as a great calamity.

Should Japan become in any degree open to European trade, Chusan, from its vicinity, must occupy a still more important position than it has ever done yet. The new whaling-trade, established by the Americans in the adjacent seas, would find it a most convenient spot for refitting and supplies, for which they now resort

to Hongkong. Nothing more would be then required to complete its prosperity but an increased cultivation of tea and silk, for both which products it possesses the exact geographical position and climate which are found most favourable on the opposite coast of China.

Previous to our occupation, Chusan and all the smaller islands of the group constituted a district under the jurisdiction of Ningpo. The principal civil authority was a magistrate of the rank of Hien, with two subordinates at Tinghae, and several others on the other islands, under his charge. He transmitted about 10,000 tales and 30,580 shih of rice annually to the government on the main.

At the head of the military establishment there was an admiral, with about 20 to 30 war-junks, and a nominal force of 5000 to 6000 men. A great part of these were mere men of straw, whose pay and allowances were drawn, in Chinese fashion, by the mandarins. It was seldom that a tenth of the number could be mustered, and it was said that at our first attack in 1840 no more than 500 men were forthcoming. Upon the temporary evacuation in 1841 the importance of the position was fully perceived by the Chinese government, and three generals, with about 10,000 men, were sent over expressly, at the same time that a militia was raised on the spot. On the second capture in 1841 these three generals all fell, one in action, and the two others by their own hands. After the conclusion of peace the Chinese government endeavoured to retain some authority over the island, notwithstanding our occupation by treaty, and an officer was stationed at *Taekoshan* with this view. But his improper interference became soon checked by the adoption of summary measures, and the inhabitants were thereby taught that no divided sway would be permitted during our occupation. When British rule became extended over the island it was the first object of our officers to put a stop to the violences and disorder which had prevailed during the war. Native constables were established in all the valleys; and these being generally men of substance and influence, and supported by our authorities, succeeded in restoring order and ensuring the security of person and property. There was, besides, a small and effective police, which, being backed on occasion by military means, expelled the thieves and robbers from the island. In a short time crime decreased, nothing was lost that did not in time become restored, or its equivalent recovered. The exemption from all taxes during our tenure of the island tended of course to conciliate the good-will of the people; and upon its evacuation in 1846 the Emperor's government did not deem it prudent to alienate the Chusanites by demanding past arrears from them. Their experience of British rule under circumstances of military conquest can hardly have failed to convey a favourable impression;

and the stimulus given to the trade and industry of the island rendered the war, in its ultimate results, a benefit rather than an infliction to the inhabitants themselves.

It is almost needless to observe that the progress of the civil war, and the vicinity of Chusan to Nanking (the most likely seat of government for a possible Chinese dynasty) are circumstances which may bring this important and highly-favoured island into very prominent notice.

XXI.—*The Peninsula and Bay of Samaná, in the Dominican Republic.* By Sir R. H. SCHOMBURGK, H.B.M. Consul at the Dominican Republic, Corresponding F.R.G.S., &c.

Communicated by the FOREIGN OFFICE.

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History.—Columbus, returning to Spain after his first discovery of the New World, passed, on the 12th of January, 1493, a high and beautiful headland, to which he gave the name of Cabo del Enamorado, or the Lover's Cape (at present called Cape Cabron). Further eastward he saw another, which he named Cabo San Feramo (at present known as Cape Samaná), the most eastern point of the so-called Peninsula of the same name. Doubling this headland, he saw a fine gulf of such an extent before him that he supposed it to be an arm of the sea, separating Hispaniola from some other land.

Here he anchored, and having sent his boats ashore, they were received by natives, who, from their ferocious looks and undaunted manners, appeared quite different from the mild and pacific people the Spaniards had hitherto met. They were of a ferocious aspect, and had painted themselves hideously in various colours. Some were armed with war-clubs, others had bows of more than a man's length; their arrows were pointed with hard wood or with bones. One of their number having ventured on board, Columbus was induced to suppose him to be of the Carib tribe, and resolved to act with caution, and, having regaled his visitor, he sent him on shore; but, as the boat approached the land, upwards of fifty armed savages rushed from an ambush. They were appeased by the warrior in the boat; and, having landed, the boat's crew mixed with the natives and endeavoured to bargain for some of their weapons, when, in an unexplained manner, mistrust arose; the natives seized their bows and clubs, and provided themselves with cords, as if they intended to capture their visitors. The Spaniards immediately attacked them, wounded two, and put the rest to flight. "This was the first

contest with the Indians, and the first time that native blood was shed by white men in the New World," says the historian of the Life and Voyages of Columbus. Alas! how many streams might have been filled, ere the century closed, with the blood of the unfortunate natives that fell victims to Spanish cruelty! Columbus was greatly grieved when he learned the accident: his endeavours succeeded in re-establishing a good understanding; and the Cacique who governed over this people, called Ciguayens by Columbus, came afterwards on board the admiral's ship, where his frank and bold manner won him many admirers. His name was Cayacoa (and not Mayobonex, as supposed by Washington Irving). After his death, his widow became a Christian, and was baptized under the name of Doña Ines Cayacoa. The Indians called the land Samaná; and Columbus gave to the bay the name of "De las Flechas," in consequence of the skirmish with the natives. He sailed before daylight on the 16th of January, and landed on the coast of Portugal on the 4th of March, 1493.

Bertrande d'Ogeron, the governor of Tortuga, having been shipwrecked in 1673 on the N. coast of Portorico, the Spanish Government, mistrusting the shipwrecked crews, sent orders for them to be carefully guarded. D'Ogeron succeeded, with three of his men, in stealing an open boat, in which he made his escape to Samaná. He found here, to his astonishment, French Buccaneers, who assisted him, and afforded him means for his return to Tortuga. D'Ogeron, contemplating revenge, and the liberation of his companions in Portorico, undertook an expedition to that island, which, however, failed; but on his way he put into Samaná for provisions and reinforcements.

These visits afforded Ogeron an opportunity of recognizing the superior advantages of Samaná. He concentrated the inhabitants who lived far apart from each other, and sent Mr. Jamet to take the command of the young colony. Père Duval was their curate. The new settlement flourished, and the young colonists felt only one want, namely, that of women; the scarcity of females obliging the greater number of the men to remain single, until chance furnished them with a remedy. D'Ogeron had caused a number of young women to be sent from France for his establishment at Tortuga. The vessel with them on board, from St. Malo, destined for Tortuga, was obliged by stress of weather to touch at Samaná, where such advantageous offers were made for them, that the master, instead of proceeding to his port of destination, disposed of the young ladies at Samaná.

The prosperity of the young colony increased rapidly, to the disadvantage of Tortuga. It raised at the same time the jealousy of the Spaniards, who considered the French as usurpers of their soil, and molested them whenever an opportunity offered.

M. de Pouançay, governor of Tortuga after the death of d'Ogeron, feeling the isolated position of the settlers, commanded them, in 1676, to abandon Samaná, and settle near Cape Français. The great fertility of the soil at Samaná, and the commodious situation of its magnificent bay, rendered the greater number unwilling to obey the governor's order, which disinclination was principally felt by the proprietors of the indigo establishments. At length, however, a tragic event settled this question. The Spanish inhabitants of the district of Cotuy planned an expedition against Samaná, the French colonists were surprised at night, and the greater number murdered. A few, that escaped, fled to Bayahá (now Fort Dauphin) and Guarico (now Cape Haytian), while others hid themselves in the fastnesses of the forests. These stragglers finally abandoned Samaná in 1700, upon the order of the French Government.

During the commencement of the eighteenth century the peninsula was neglected, until the Government of Spain directed a colony from the Canary Islands, usually named Isleños, to be sent thither. Don Francisco Rubio y Peñaranda, then governor of Santo Domingo, executed this order, and built a small town in 1756, the church of which was dedicated to Santa Barbara. A village, founded on the southern side of the bay, which forms a fine savana stretching to the shores of the gulf, received the name of Savana de la Mar.

The colonists had been provided with cattle and fowls; and hogs were found wild in the mountains. But such ill success accompanied the enterprise that these towns sank in a short time to inconsiderable establishments.

In 1763 Count D'Estaing, as Governor-General of Martinique, conceived the idea of inducing the Spanish Court not only to cede Samaná to France, but the whole "northern coast from Monte Christi to Samaná, a district including the fertile valleys of the rivers of Yaque and Yuna." * The negotiations, which had already considerably advanced, were suddenly broken off by the Court of Madrid. The limits between the French possessions in the west, and the Spanish in the east of Hispaniola, were settled by the Treaty of Limits in 1777, Samaná remaining in the hands of Spain.

When the insurrection of the slaves broke out in the French colony a number of planters and colonists sought safety in the Spanish territory. Some of these refugees settled in Samaná, where they combined with the remnant of the emigrants from the Canaries for agricultural purposes, and the fertile soil crowned

* M. Weuves, in his 'Réflexions historiques et politiques sur le Commerce de la France avec ses Colonies,' published in 1780, observes that Hispaniola and Cuba furnish the keys to the Gulf of Mexico.

their endeavours with success. Coffee and cocoa plantations arose, and even sugar was cultivated.

The ideas already entertained by d'Ogeron of incorporating the Spanish portion of the island with the French, and which Count d'Estaing had afterwards revived, were realized by the Treaty of Basle, concluded between France and Spain on the 22nd of July, 1795. By the 9th Article Spain ceded to France the eastern part of the island of Santo Domingo, in consideration of the latter power giving up all her conquests in the Pyrenees. Several years having elapsed, Toussaint L'Ouverture, who then commanded as General in Chief of the French forces in Santo Domingo, marched upon the city of Santo Domingo, and insisted upon the execution of the treaty, by taking possession in the name of France of the Spanish territory. The Spanish colours were lowered, and the French tricolor waved, on the 27th of January, 1801, over the whole island. But the French Government mistrusted Toussaint, and the First Consul despatched his brother-in-law, General Le Clerc, with a fleet, consisting of upwards of 60 vessels, among which there were 36 of the first class to Santo Domingo. The formidable fleet having selected the bay of Samaná as rendezvous, entered it towards the latter end of January, 1802. When Toussaint received information at the city of Santo Domingo of the arrival of these vessels, he proceeded with all speed to Samaná; and when the sight of this grand fleet at anchor in that magnificent bay burst upon the black general he exclaimed to his staff—"Nothing is left to us but to perish—all France has come to Santo Domingo — she comes to revenge herself, and to annihilate the blacks—we must perish."

Samaná received a French garrison. The small town was fortified, and the principal points of the coast provided with defences. The prosperity of the inhabitants increased during the occupancy of the French. In 1808, when Napoleon usurped the throne of Spain, Asturia rose "*en masse*," and as the pulsations of that patriotic movement were likewise felt in Santo Domingo, the Supreme Junta of Sevilla confided certain powers to Don Torribio Montes, Governor of Portorico, who sent secret emissaries to Santo Domingo, for the purpose of exciting the Spanish colonists against the French, then still in possession of the city of Santo Domingo and Samaná. George III., by an order in council, dated 4th of July, 1808, made peace with Spain; and the British Cabinet having declared themselves willing to co-operate with the Spanish patriots, the Supreme Junta of Sevilla declared war against the Emperor Napoleon. The Spanish population of the eastern part of Santo Domingo, headed by Don Juan Sanchez Ramirez, formerly Commandant of Cotuy, rose against the French, and at the battle of Palo Hincado, Sanchez, the Patriot

general, beat the disciplined troops of the French general, Ferrand, who in disgust shot himself.

The city of Santo Domingo was now closely besieged. An English squadron, consisting of three frigates and two brigs, under the command of Captain Dashwood, was despatched from Jamaica, and entered the bay of Samaná on the 10th of November, where they captured five vessels, and having disembarked the marines, they scaled Fort Santa Barbara, and threw the guns down the hill on to the beach.* The French commandant, Castel, was obliged to surrender; and Captain Dashwood, having effected this, delivered the place over to the patriots, under General Sanchez, upon condition that the rights of the French inhabitants should be respected and their property secured to them. The population of Santa Barbara consisted at this period of upwards of 1000 souls.

The French were now reduced to the sole possession of the city of Santo Domingo, where they were closely besieged by General Sanchez, and an English squadron under Commodore Cumby. Some land forces, commanded by General Sir Hugh Carmichael, also assisted the efforts of the patriots. The combined forces obliged General Barquier, who commanded the French garrison after the death of Ferrand, to capitulate on the 11th of July, 1809, to General Carmichael, who took possession of the city. The Supreme Junta had proclaimed General Sanchez Captain and Intendent-General of the Spanish colony of Santo Domingo, and when General Carmichael evacuated the city, he delivered his authority over to him. By this event the whole of the former possessions of the Spanish Crown in Santo Domingo were restored to that nation; and the 8th Article of the Treaty of Paris expressly stipulated that "that part of Santo Domingo ceded by the peace of Basle to His Most Christian Majesty, should be restored to His Catholic Majesty in full property and sovereignty."

Samaná remained in oblivion until 1821. Excited by the previous movements in Mexico and Venezuela, Santo Domingo, the metropolis of the Spanish colony, declared itself independent of the Mother Country, the insurgents hoisting the Colombian flag, and giving to the new state the name of Spanish Hayti.

This dream, however, did not last long; General Boyer, then President of the Republic of Hayti, had long coveted the annexation of the eastern part; and having learned that the step taken there in declaring itself an independent state was not generally approved, he marched suddenly, in 1822, upon Santo Domingo. The new Provisional Government being little prepared for such

* The British vessels employed in this service were the frigates Franchise, Aurora, and Dædalus, and the Reindeer and Pert brigs. Several of these guns are still lying on the beach surrounded by a thick incrustation of sand and pebbles, cemented by oxide of iron.

an attack, surrendered to Boyer, who declared the eastern part annexed to Hayti, uniting thereby the whole island under one government.

Samaná was destined to see, in consequence of this movement, another French fleet anchored within its spacious bay.

Vice-Admiral Jacob, as I learn from the work of a late French author,* anchored within the bay of Samaná, in March, 1822, with 11 vessels and 1200 troops, the latter under the command of Colonel Barré. General Donzelot, who then governed Martinique, fitted out this expedition, and a detachment of troops were disembarked at Savana de la Mar, where they entrenched themselves. President Boyer now sent one of his aides-de-camp to inform the Commander-in-Chief of the French squadron that, if the troops under his command committed any hostile act, every Frenchman still residing within the Haytian Republic would be massacred.

A few days after this communication the admiral's ship having weighed her anchors, departed, and the remaining ships soon followed.

The eastern part of Santo Domingo continued under the Haytian Government for 22 years, until the Dominicans, finding the yoke insupportable, rose in the metropolis on the 27th of February, 1844, overcame the Haytian garrison, and declared their independence, under the name of the Dominican Republic, with the motto of "God, our Country and Liberty."

Great Britain was the first Power to acknowledge the Dominicans as a free and independent nation, and entered in 1850 into a formal treaty with them. France and Denmark have since followed this example; and although the Emperor of Hayti, Faustin I., better known under the name of Soulouque, has not yet recognised the Republic, there exists every hope that, through the mediation of powerful nations, he will soon be induced to do so.

These historical remarks, although they occupy several pages, have been requisite, in order to give some general idea of events intimately connected with the Peninsula of Samaná, and essential in showing its importance. I shall now endeavour to give a description of its geographical and physical features.

Geography.—At the north-eastern point of the Island of Santo Domingo, which Columbus called Hispaniola, or little Spain, stretches a narrow tongue of land for 32 miles due E.; the most eastern point being known as Cape Samaná or Cape Rezon, called Cabo de San Feramo by Columbus. This tongue is delineated in ancient maps as an island, showing a communication at its

* Saint-Domingue, Etude et Solution nouvelle de la Question Haytienne, par M. R. Lepelletier de Saint-Remy. Paris, 1846. Vol. ii. p. 248.

neck, or narrowest western part, between sea and sea, but in later times the existence of such a communication has been disputed. The best proof of its existence, however, is, that in the commencement of this century the flat-bottomed boats of Samaná, which carried on commerce between the so-called peninsula and the northern ports of Porto Plata, Montechristi, Guarico, &c., *passed through* the Gran Estero, one of the numerous channels by which the narrow neck is interlaced, being a shorter route, to gain the sea on the N. side, and principally thereby to avoid the stormy seas off Cape Samaná and Cabron. This channel is at present filled up with sand, but could be easily re-opened, and afford a passage to boats from the bay of Samaná to the sea on the N.

The isthmus is low; the mountain-chain of Montechristi ceases suddenly on approaching it, and rises again on the eastern bank of the Gran Estero, favouring by its structure the idea that Samaná was once an island detached from Santo Domingo.

I have already observed that its whole length is, from W. to E., 32 miles. The low, swampy land near the isthmus is about 5 miles wide, having its greatest breadth between Punta Balandra and Cape Cabron, where it is 11 miles across. Samaná is traversed by a central chain, rising highest at its eastern part. The Sugar-loaf Mountain near Cape Cabron is 1936 feet high, and La Montaña del Diablo, 1300 feet.

I have calculated the area of Samaná at 225 square miles, and its circumference, following the sinuosities of the bays, at 95 miles.

The beautiful bay, which so much attracted the attention of Columbus, and appeared to him like an arm of the sea, opens between Cape Samaná on the N., and Cape Raphael on the S. The distance between these two points is 21 miles N.W. $\frac{3}{4}$ N., reckoned from Cape Raphael.

The bay extends 30 miles to the mouth of the Yuna, one of the largest rivers of the Republic, which flows into it at its western bight. The breadth of the bay has been greatly overrated. It may be reckoned 8 miles from Samaná to Savana de la Mar. At a distance of 10 miles to the westward of Cape Raphael commences, near Punta Jicaco, a reef, which stretches, more or less interrupted in its continuity, north-westward to a number of islets and rocks, called the Cays Pascual, Alevantado, and Arena; better known under the name of the Banister Cays, or, likewise, Los Cayos Alevantados. The reef continues from thence, more or less interrupted, towards Punta del Capitan, which forms the western point of the Puerto de los Colorados of the old Spanish charts.

This formidable reef, which in some parts of its structure has the appearance of a barrier reef, protects the basin of the gulf

against the heavy seas, which otherwise every gale from the N. and E. would send into it. It has, however, its disadvantages also. The passage for vessels is contracted to a mile in width between Punta Cacao and Cayo Pascual, and is moreover impeded by a shoal with only 24 feet water over it, lying N.W., 6 cables' length from the northern point of Cayo Pascual, which renders it hazardous for vessels of large size leaving with the prevailing sea-breeze. It is therefore advisable to stand out to sea with the land-breeze only.

These dangers have often proved fatal to navigators. Spain here lost in 1724 two galleons, La Guadeloupe and La Tolose, each of 70 guns, under the command of Don Balthasar de Guevara; and the French 74-gun ship, Scipion, after a running fight of 8 hours with the London, 98, and Torbay, 70, attempting to enter English Harbour near Punta Jicaco, struck, and was totally lost. Her consort, the frigate Sibylle, escaped.

The bay of Samaná, *within the reefs*, offers shelter for the largest fleets. As already observed, the French fleet of Admiral Villaret-Joyeuse, with the army under the command of General Le Clerc,* was safely anchored here. Besides the principal bay, it has several lateral anchoring places, or "Surgideros," among which the Bahia de San Lorenzo, or "de las Perlas," on the southern shore, may be mentioned.

The first port after having passed Cacáo, which is a rocky bluff, with a fort on it, and after having cleared the Cayos Alevantados, or Banister Cays, is the Surgidero del Carrenero chiquito. A reef extends from Punta del Lirio, its western point, and narrows the entrance. Between Punta del Lirio and the point of the fort of Punta Gorda is an anchoring place for small vessels. Four cables to the W. of Punta Gorda lies the most eastern of three small cays, called Cayo Paloma, or Pigeon Cay, with a reef on its western point. Between this and Punta Gorda is the entrance to Port Santa Bárbara. The islet next to Paloma is called Carrenero Grande, which has a battery, called Fort Servante, upon it. The passage is further contracted by a reef, which extends from Cayo del Carrenero Grande northward, and another off Punta Gomero; but these obstacles once cleared, the Port of Santa Bárbara is very safe. A vessel may lie close to the shore, and be repaired or careened with facility.

The vast sheet of water which expands between shore and shore offers good anchorage in most of its parts. From Punta and Isla del Corozo extends a reef and shallow S.S.E., about 6 miles, and another from Punta del Mangle, in the same direction.

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* Napoleon's sister, Madame Le Clerc, and younger brother Jerome, were on board of this fleet, the latter to commence his naval career.

The bay, of which Punta del Corozo forms the western point, and Punta del Mangle the eastern, affords an excellent harbour. Punta del Corozo was formerly known under the name of Punta Martiniqueña. The airy situation of this point, which projects considerably to the S., and its springs of fresh water, render it, no doubt, more preferable for the site of a town than where Santa Bárbara is now situated. The French were sensible of this local advantage, and had in contemplation to found here the town of Napoleon, and the ground was laid out for this purpose; but before the plan was executed they were expelled from Samaná.

The Spaniards had near Punta Gorda, where the small brook Almaçen flows into the bay, large warehouses. The produce of the country was brought down the Yuna, and stowed here until the Spanish vessels arrived to take it off from the commodious bay near Punta Gorda.

The principal mouth of the Yuna lies S.W. $\frac{3}{4}$ S., $5\frac{1}{2}$ miles from Punta Gorda. This river rises in the central mountain-chain, on the highest peak of the Cibao, and having passed close to the town of Cotuy, receives on its left side the Camu. The flat-bottomed boats of the Spaniards ascended to the junction, and even to Angelina, a farm on the right bank of the Yuna, several miles above the place where the Camu joins it. At present it is navigable for boats drawing 4 to 5 feet water to the junction of the Quaba, or rather where this tributary of the Yuna is joined by the Jaigua. I embarked here in August, 1851, and sounded the Yuna to its entry into the bay of Samaná. I found the lowest water near the Chorero and near the river Yáya, where there were only from 6 to 7 feet.

The banks of the Yuna are highly fertile, but want cultivation. There are occasionally houses and plantations to be met with, but only few and far between. The greatest plague of these habitations are the mosquitos, which, in consequence of the low banks and stagnant waters, are here in swarms.

About 23 miles from the mouth of the Yuna, on the left bank, is a settlement called Almaçen, where the Spanish Government had warehouses to store the tithes of tobacco and other produce of the fertile valley of La Vega-real, and from whence they were sent to the Almaçen of Punta Gorda. The lowest water from the mouth of the Yuna to Almaçen was, in August, 1851, $9\frac{1}{2}$ feet. The tide extended at that period to Trujillo, a hamlet on the right side. The banks here become low, with many esteros or lagoons, and about four miles from the point where the Yuna enters the bay it throws off a branch on its left side to the N.E., while the main branch continues E. by S. The stream ran here with a swiftness of 4 miles per hour, and rendered the utmost skill necessary to prevent the boats from

coming in contact with the numerous snags that impeded its course. The small arm to the N.E. is called Caño Trujillo; and it has a communication on the left bank by means of the Guayába with the esteros that extend to Almaçen. At a short distance from where the Trujillo enters the bay it extends a branch to the N.; this is the Boca del Gran Estero, by which, as already observed, boats could formerly proceed to the sea on the N. side without rounding Cape Samaná. The entrance is now overgrown with mangroves. I found only 3 to 4 feet water, while in the Caño Trujillo, near the Gran Estero, I could find no bottom with a 15-feet line. The Caño Trujillo flows about 2 miles to the N. of the principal trunk of the river, in three branches, into the Bay of Samaná.

Unfortunately for the navigation of this fine river, a shallow sandy bar, with only $2\frac{1}{2}$ to 4 feet of water over it, barricades the Yuna and its Caños. There are, moreover, heavy rollers upon it during a strong breeze. This difficulty might be overcome by the help of engineering skill, and the Yuna rendered navigable for steamers as far as the confluence with the Camu.

The advantages of this river, as a high-road to the fertile districts of La Vega and its pasture-grounds, to the mineral district of Maymon, and the pine-forests of the Cibao, are incalculable.

Turning from Boca de Yuna to the southward, we meet the Barranca Chica and Barranca Grande; both anchorages at present are not used. The Naranjo here enters the Bay of Samaná, passing under a hill of calcareous rock, through which it has pierced its course. Proceeding eastward from the Barranca Grande, the coast is iron-bound—that is, it consists of calcareous hillocks and rocks—permitting no approach to the shore. This part is called the Coast of Haïtis (Haïti being the Indian name for hill), and extends to the Bahia San Lorenzo. A description of this very remarkable part will be given under the geology of this district.

The Bahia de San Lorenzo, or De las Perlas, forms an excellent port, perfectly land-locked and safe. From its eastern point a shoal stretches about half a cable's length out; the entrance has, otherwise, from 18 to $6\frac{1}{2}$ fathoms water. It is not, however, advisable to anchor at a great distance from the entrance, although this handsome and extensive bay stretches a great distance E. by S., and affords sufficient depth for nearly a mile. The course out of the bay is W. by N.

Four and a half miles farther to the E. is the mouth of the river Yabon, and one and a half farther on, the village Savana de la Mar.

The bay in front of Savana de la Mar is shallow, and does not permit large vessels to anchor close to it.

The Port de los Colorados was formerly resorted to; but it is now called Puerto de la Punta del Capitan, from a high mountain which bears that name, from the side of which a rivulet flows into the bay. Further eastward is the Rio Magua and the Rio de las Culebras, or Snake River. The latter is merely an inlet winding between numerous mangrove bushes, and communicating with the Jayan. Punta de Mangle (Punta del Manati of the old charts) is the most northern point on the S. coast, Cape San Rafael excepted. A fine bay here opens by doubling this point, in which El Morro Gordo attracts particular attention, being a rounded hill projecting into the bay, and connected with the coast by a narrow neck. To the S.E. of it is Puerto Jicaco, called in the old Spanish charts Puerto de los Ingleses, or English Harbour. It is protected by a reef, having two passages. The appearance of this reef, chiefly at the S.E. of Punta de Mangle, is very peculiar, and resembles a barrier reef. The Morro Gordo has several houses on its summit, from which the view is very interesting.

Some miles further eastward is the mouth of the Yeguada, and beyond it the Hobero, which, I understand, is merely an eastern branch of the Yeguada. A road leads from La Yeguada, between the mountains Corcovado and Haitis, over the central mountain-chain to Seybo, the principal town of the province of the same name. The highest pass, El Tocon, is, according to my observations, only 1500 feet high; the ascent, nevertheless, is very difficult. There is a weekly communication by a post-boat between Hobero and Samaná. Passing the mouth of the river Guanábo, we arrive at Mount Redondó and Cape San Rafael. This is a tongue of land stretching E.N.E., from the midst of which rises the Redondo, or round hill, an excellent landmark for mariners.

The bay of Samaná and its shores having been described, it remains to say a few words of the eastern and northern coast of the peninsula. Rounding Punta Balandra, the southernmost point, we arrive at Puerto Frances, or French Harbour, seldom visited by vessels. Having doubled Cape Samaná, and passed Madamitas, we come to Las Galeras, where a vessel may anchor under the lee of a small islet. Rincon, further northward, under Cape Cabron, is greatly filled with reefs. Doubling Cape Cabron, we arrive at Puerto Escondido, called in the French charts Porte Petit Gosier, which is sometimes visited by small coasters. A short distance from thence is the mouth of the San Juan, properly Jayán, the largest in Samaná, and which is very difficult of access. A vessel while at anchor here is exposed to all winds.

Hermitaño is equally difficult of access; but an islet lies in front of it, surrounded with reefs.

The Limon, next in size to the San Juan, opens into the sea

about 7 miles to the W. of the latter. Here the different routes of the peninsula, leading to Matanzas, Macoris, &c., unite in one. On the left bank of the Limon is a military post.

Punta de los Pescadores and Boca del Astillero are good anchorages for coasters during calm weather; but Lateriena and Punta de Moretes are dangerous, in consequence of numerous reefs. Indeed, the only good port on the northern coast is Port Yaqueson (Jackson), where vessels of large size lie under the lee of a small cay, that protects the anchorage. A short distance further northward is Boca del Gran Estero, the northern outlet of the communication by the Caño Trujillo with the western bight of the Bay of Samaná.

Port Jackson has been called the key of the N. coast of Samaná, and a single man-of-war stationed here would command the only passage of communication with Samaná by land from the Cibao. From Port Jackson a number of hills along the coast extend to the eastward; they are not high, but rugged, and the road over them leads towards Boca Limon. When Santo Domingo was under Haytian government, General Borgela gave orders to form another road inland, starting from Gran Estero, and leading to the Cañitas on the S. side of Samaná—as, should a foreign war break out, an armed vessel at Port Jackson could prevent all communication between Samaná and the rest of the island; but the difficulties proved too great for the Haytians, and the works, though commenced, were discontinued.

El Gran Estero may be taken as the western limit of the peninsula of Samaná. A small village, called Matanzas, lies 2 miles further to the W., on the coast of the Bahia Escocesa, likewise known as the Bay of Cosbeck, the latter probably a corruption of Scot's Bay.

Geology.—We have observed that a central chain traverses the peninsula from west to east. This consists chiefly of mountain limestone, schistose rocks with veins of calcareous spar, sandstones, &c.; quartz occurs frequently, and at the eastern end there are mica slates. The shores exhibit shelly conglomerates belonging to a recent period, the dip being to the S. of W. under a low angle. The fossil shells which I found belong to a recent period, consisting chiefly of strombus pugilis, acciptrinus, bitupercluris, murex calcitrapa, ponicum, &c. Near the rivulet Almaçen are large veins of bituminous coal, which are likewise met with further to the eastward. The layers are horizontal, the direction E.N.E.; but, as far as investigations have hitherto been carried on, the coal is too bituminous to be employed in steamers. The experiments not having been followed up with even common energy, it is impossible to pronounce a decided opinion upon this subject. I do not think, however, that in any of the localities where the coal is

found excavations to a depth of 10 feet have been made. The geological structure of the country does not preclude the possibility that coal of a good quality may be found below. The fallacy of the opinion, entertained by some geologists, that no good coal could be found within the tropics, has been established by the excellent mineral of that kind, recently discovered near Acapulco, which is more than 2° farther S. than Samaná. The advantages which the discovery of good coal would confer upon the Dominican Republic are of such vital importance, that nothing but the supineness of the Spanish race, still more innate in the Creole than in the inhabitants of the Mother Country, can explain why investigations have not long since been made.

Coal is not the only mineral which is produced in Samaná; copper and gold, the latter in small quantities, have been met with, and it is even asserted that platina has been found. Iron-ore is frequent; nevertheless, the most important feature in respect of minerals is the probability of the existence of serviceable coal-fields.

Calcareous rocks form the prevailing feature in the geological structure of Samaná. They rise to high pinnacles, engulf rivers, or communicate their chemical elements to their waters, which, in falling over banks and ledges, encrust vegetable productions with a thick coating. The Chorera, near Punta de Terro, exhibits this in a remarkable manner. The rivulet falls over a ledge into the bay, and the banks being overgrown with mangroves, the long branching air roots of that tree (Rhizophora mangle) are entirely incrusted with calcareous matter. Another rivulet, the Coco, tumbles over a precipice nearly 100 feet high. It contains lime in solution, but the rocks over which it falls are schistose, traversed by quartz veins. This cascade is highly picturesque, and the way to it overland through Honduras highly interesting. On a hill close to the cascade I found splendid clusters of crystals of selenite.

But the most remarkable feature of the limestone formation is seen at the Haïtis of the bay of San Lorenzo, the Bahia de las Perlas of Columbus. After having passed the rollers at the bar of the Yuna I saw, at a distance of 7 to 8 miles, a number of insulated hills, resembling conical beehives, placed close to each other. By means of my glass I observed that they stood isolated, sometimes fronted by sharp rocks, against which the sea raged furiously. Not having before heard of them, my curiosity was greatly raised as to their nature, and I learned from the pilot that they bounded the Bahia of San Lorenzo.

I visited the bay on the 9th of August, and coming round the eastern point, a large number of isolated hillocks of a conical shape, from 80 to 150 feet high, were before me, generally

denuded of vegetation to a height of from 10 to 20 feet, from thence partially and sparingly overgrown with plants to the top. To the traveller among the native tribes of Guiana the appearance of a Macusi or Wapisiana village seen in the distance will give an idea of these hillocks.

The action of the sea has partially undermined many; others contain caverns, two of which I will attempt to describe. The first is to the S.W. from the entrance of the bay. The visitor lands on a sandy beach, where the presence of a few cocoanut-trees strikes him with wonder as to how they came there. This cavern is about 15 feet above the sea, but not of sufficient grandeur to cause great interest. We next proceeded to the great cave, round the western point of the bay. The conical hill which contains this cavern is somewhat difficult of access; but we climbed up amidst the spray of the sea. The entrance to the cave is from the N., and is about 60 feet in height. While stepping over its precincts I saw to the E. a high stalagmite figure, to which imagination could easily give the shape of an Achilles standing on a pedestal, bidding defiance to intruders. On the western side, likewise on a pedestal, appeared a gazelle. I could not measure the Achilles, but the concretion of carbonate of lime which composed the latter was $20\frac{1}{2}$ feet in height. The roof of the grotto is ornamented with numerous stalactites, and is in its highest part about 70 feet from the floor. The cavern containing these two figures is from E. to W. 150 feet in extent. There are excavations or reservoirs in it, with a large quantity of fresh and delicious water. A small opening leads to a side cave, with a concretion or mass, resembling a sarcophagus covered with a pall. Where this cavern opens to the light a large fig-tree has sent its gigantic roots to the floor of the cave.

On the S. side of the great entrance the rock is covered with a greyish coating as if a veil had been spread over it. The listener hears, inside the wall of the cavern, water dropping steadily and uniformly, causing a sound like the pendulum of a clock. A narrow dark entrance admits to a second large cave. It was tenanted by a multitude of bats, which encircled us intruders in rapid flight, coming nearer and nearer, so that we had at last to defend ourselves and prevent the torches being extinguished. Another lateral excavation descends towards the sea, from which, during stormy weather, large quantities of driftwood is washed up.

These caverns were in former times resorted to by the aborigines, and we learn from writers contemporary with their discovery that the Indians had great veneration for caverns, where they adored their gods, and believed that mankind was first created and then issued from them. The sun and moon came likewise out of a cave called Tovobaba. I discovered on some of the rocks in

the large grotto Indian figures carved in the rock, and also large heaps of shells, almost exclusively of the *strombus pugilis*, with a few *turbinellæ pugilares*, *aviculæ*, and *ostreæ*. It is almost impossible to give an idea of the quantity of these shells. Tons of lime have already been carried away by the inhabitants of the neighbourhood: the streets in Savana de la Mar have been paved with them, and still there are immense quantities remaining in the caves we visited. Although no less than three centuries must have elapsed since these shells were thrown into these heaps, the greater number still possess their vivid orange colour near the columellar lip, as if they had only been taken yesterday from the sea. This refers likewise to the *aviculæ* still attached to the branches of the mangle tree. The latter species of shells seems to have existed in large quantities in the bay, from which circumstance, no doubt, the Bahia de San Lorenzo was formerly called the Bay of Pearls.*

From the excavation which I called the sarcophagus room a small opening leads to another cave, with a hole about 20 feet in diameter admitting light, from which, to the southward, is another large dark cave, with heaps of shells, among which I found a piece of urn-shaped pottery, a valuable relic from the Indians. The opening in this terra cotta ornament makes me believe that it was used as a musical instrument, for which object a long reed was probably introduced into it. A similar instrument, but with a calabash instead of pottery, is called by the Indians in Guiana "Couti and Tsapupu."

These caverns may have been used as a retreat, or at certain times as places of assembly, or for religious rites, by the aborigines, hence the enormous quantities of shells, which they probably collected in the gulf. I am assured by the fishermen, that this shell (*strombus pugilis*) is now extinct in the bay.

It must be noted that these caves are all in one of those remarkable conical hills of limestone, having the character of a recently-formed rock, containing fragments of shells and other organic bodies.† The rock shows evident marks of having been subjected to extreme heat. Here it looks like red bricks; there it is crystallized, or seems to contain flakes of felspar; in other places it is simple limestone. Igneous causes, earthquakes, and the formation of monticules during such catastrophes, mud volcanoes, like those at Bakú, in the province of Shirwan, on the Caspian Sea, where clay replaces lava—seem to me the only phenomena that can explain the production of these conical mounds,

* Specimens of these shells have been sent to the British Museum.

† Large specimens of this rock, numbered 54 to 57, have been sent to the British Museum in my series of geological specimens from Santo Domingo.

which contain *no traces of lava, pumice, or scoriæ*, as far as I have been able to examine them,* but my visit was too short to permit me to institute accurate examinations. I have reason to believe that these conical hills extend in a S.W. direction over a space of 10 miles towards Boya.

Evening was already approaching when our boats left the Haïtis; the waves, moved gently by the breeze, beat into the excavations under the Haïtis, and produced a mourning sound, which imagination might have ascribed to the lamentation of the ghosts of the departed Indians, wailing their misfortunes, and their annihilation by the white race.

Productions. — The soil of Samaná is highly productive, which is shown in the gigantic trees which still cover the hills that extend towards the sea-shore. The sides of the mountains have been only partially cleared, and cultivation has only commenced its inroad on the great primeval forest. The mahogany, or *caoba*, as it is here called, deserves to be first mentioned. It is an article of spontaneous growth, and constitutes the greatest export. There are still a number of these trees to be seen in the mountain forests, promising employment and profit for years to come. Espinillo, caya, cavima, &c., are some of the other forest trees for cabinet-work. Roble and asaroble-wood are fit for naval architecture, and indeed vie in quality with the mora, or greenheart of Guayana.

The capá is particularly suited for the bottoms of vessels, and is almost impervious to worms.

Lignumvitæ and fustic are likewise to be met with.

When the Flibustiers from Tortuga first settled at Samaná they cultivated principally indigo. Cacao, cotton, and roucou were indigenous, and coffee-plants were introduced in the 18th century from the French colonies. This plant thrives uncommonly well, and the quality of the coffee at Samaná is excellent.

I am persuaded that the coffee of Samaná would vie with the best Martinique or Jamaica, but at present only vestiges of the former plantations are to be seen. The present inhabitants are satisfied with cultivating yams, batatas, Indian corn, and fruits, principally oranges, mangos, alligator-pears, cocoa-nuts, &c. The luxuriant appearance of the fruit-trees struck me forcibly during my visit. It was at the period of the mango season, and the trees were loaded with them. They were, however, of so little value, though the majority of the trees were of the superior species

* Among the fragments thrown out from Graham Island were dolomitic limestone. Leopold von Buch found the old lavas of Lancerote covered by a thin stratum of limestone, from an inch to two feet in thickness, being of a hard stalactitic nature, and containing fragments of terrestrial shells. The rock of the Haïtis may have a similar origin.

called the peach-mango, that even the frogs seemed satiated, and left them in numbers to rot under the trees.

The yams of Samaná are superior to any other in Santo Domingo, and are sold at Samaná at 1½ to 2 dollars per barrel.

The bay of Samaná abounds with fish. The whale visits it in spring in large numbers. The coast near the Yuna abounds in oysters, among which are likewise found species of the genus *avicula*. Aquatic birds visit the bay and the Esteros in large flocks, principally flamingos, spoonbills, the scarlet ibis, the pretty egrette or garza (*ardea candidissima*), snipe (*scolopax gallinago*, Linn.), sarapicos (*tringa* and *totanus*), gallitos (*parra jacana*), gallinuelas (*rallus* spec.), gallaritas (*fulica leucopygia*, Wag.), and other gallatores. Of *palmipedes* there are at least ten species, but principally and foremost is the delicious yaguaza (*anas arborea*, Linn.), which abounds along the banks of the Yuna.

Population, &c.—Although nature has done so much for this tongue of land, man inhabits it but sparingly. We have seen that Columbus found at his first visit to Samaná a large tribe of warlike Indians of ferocious aspect and hideously painted. He and his companions took them to be a branch of the dreaded nation of Caribs.

The quantity of broken pottery found in various situations at Samaná, proves that it was once thickly peopled.*

I have already alluded to an interesting Indian relic found at the great cave of San Lorenzo; but the most remarkable specimen of the antiquities of the natives is the head of an Indian, sculptured out of hard trappean rock, which was found near Cabron, where the formidable Mayobanex, Cacique of the Ciguayens, is said to have had a residence. This relic, measured round the ears, is seventeen inches in circumference, and weighs above ten pounds. It represents in its flattened forehead and harsh cheekbones the typical feature of the Aymaras of the province Muñecas.

The present population consists partly of the descendants of the Canarians or Isleños, of French refugees from Hayti, of Creoles from the same part, and of Spaniards from Santo Domingo. In 1824, another element was added to this mixed population in some coloured *free* people, who emigrated from the United States when Boyer was President of the Haytian Republic, and settled at Samaná and other places. When the Dominicans declared themselves independent of Hayti, a large number left the penin-

* Broken pieces of terracotta are found in large heaps at various places. It seems they have been broken intentionally, as there is no evidence that the pottery was ever in use. These places were probably altars, and the terracotta heads and ornaments upon them are the remains of sacrifices. Some of these ornaments resemble occasionally the Egyptian.

sula, while the remainder continued, by their industrious and quiet habits, to enjoy the respect and consideration of the Dominican government. In taking a ride over the mountains to Honduras and to the mouth of the Coco, I was surprised at being accosted in three different languages by the people whom I met, namely, English, Spanish, and French. The latter distinguish themselves by the neatness of their habitations, the Americans by the cleanliness of their provision-grounds and their industry. In 1851 the population of Samaná was 1721, of whom about 300 were Americans and their descendants.

Samaná has its chief commerce with the Turk's Islands, which are barren spots without vegetation, and only famed for the large quantities of salt that they export. These isles depend principally for vegetables, cattle, and poultry, upon Samaná and Puerto Plata. Some mahogany and other woods are likewise exported from the peninsula. The small town of Santa Bárbara occupies the bight and acclivities of a bay which I have already described. It was founded in 1756, by Don Francisco Rubioy Peñarando, then Governor of Santo Domingo.

The church was originally built of stone, but is said to have been destroyed by an earthquake.

The town consists of about ninety houses and huts, and presents a complete picture of decay. The government-house, of wood with galleries, is the best building; besides this, there are two or three of a similar description; but the rest are buhios, that is, buildings, the sides of which are boarded with palmwood and the roofs covered with palm-leaves.

There is a Custom-house in Samaná, it being declared a port for imports and exports; but this is of very little importance where industry and population alike lack to call forth the advantages which a fertile soil and favourable situation afford.

On a small hill is seen a neat building of wood, behind which is another equally neat, but smaller. These are the Wesleyan chapel, and the temporary habitation of the missionary of the London Wesleyan Missionary Society, residing at Puerto Plata, but who occasionally comes here to administer religious rites to his congregation, which consists principally of American emigrants and their descendants. There is a school connected with this, over which a master presides, who, during the absence of the minister, acts in his stead.

During my stay at Samaná, I occupied the minister's house, and determined its position to be lat. 19° 12′ 30″ N., long. 69° 19′ 18″ W. Fort Santa Bárbara bore from here S. 55 E., distant about ½ mile. The hill upon which the chapel stands is 45 feet above the sea. Santa Bárbara forms a kind of penal settlement for the Dominican

republic. There are a number of political and other prisoners exiled to Samaná, which circumstance requires it to be strongly garrisoned. The population, consisting only of 1721 individuals, has to furnish a garrison of 220 men. Santa Bárbara is defended by the fort of the same name, now mounted with three guns, two of 24, and one of 18 lbs.; and Fort Libertad, which commands the former, has four guns, three of 18, and one of 8 lbs.

These two forts command all the approaches to Santa Bárbara from the land side, but the guns are by no means in good order. The entrance to the port is, moreover, defended by Punta Gorda, with two pieces of 24 lbs., well mounted, and by Fort Servando, which at present possesses no guns, those which were there having been transported to Fort Cacao.

Nature has done much for the defence of the entrance to the bay of Samaná. The reef stretches to the Cayos Alevantados, preventing the approach of a hostile force from the E. Opposite these Cays is a projecting, bold bluff, called Cacao, distant from the nearest Cay about a mile. Hence a strong water battery, erected at Pascual and Cacao, well mounted, would place any vessel attempting to enter under a destructive cross-fire. Fort Cacao is armed with 7 pieces, six of 24 pounds, and one of 8, of which, however, only four are well mounted.

The favourable situation of these Cays for preventing the approach of an enemy, was signally proved by Jack Banister, an Englishman and a celebrated pirate, at the close of the 17th century. He had arrived with a consort vessel, commanded by a Frenchman named Lagarde, at Samaná, and the commanders of two English frigates, having learned that Banister was anchored at Samaná, prepared to enter the bay. The pirate immediately had the guns of his vessels put ashore on one of the cays, and defended the entrance with the crews, consisting of 200 men, in such an effective manner, that he killed more than 120 of the assailants, and forced the frigates to retire. Banister's own ship was, however, disabled during the engagement; and the smaller French vessel only remaining for embarkation, all rushed towards it, and a vast number were drowned, or perished in endeavouring to get on board. The cays have, in consequence, received the name of Banister.

The guard at the mouth of the river Limon has three pieces for defence—namely, one of 24, and two of 18 pounds; these are, however, dismounted at present.

A perfect defence of the bay of Samaná would require the erection of a fortified position at the western point of Jackson and at Las Cañitas del Sud, or at the point E. of it, called Punta Gorda, near the river Yuna. Although the Haytians did not

succeed in re-establishing the communication by the Gran Estero, two companies of European Sappers and Miners would easily effect it.

I have purposely dwelt long and in detail upon this narrow strip of land, called the Peninsula of Samaná, and upon its adjacent magnificent bay. In its *geographical position* its greatest importance is centred. The fertile soil is fit for the cultivation of all tropical productions; its spacious bays and anchoring places offer a shelter to the navies of the world; and its creeks afford facilities for the erection of arsenals and docks, while the adjacent forests yield the requisite woods for naval architecture; still its chief importance does not consist in these advantages alone, but in its *geographical position*, forming, as it does, one of the principal keys to the isthmus of Central America, and to the adjacent Gulf of Mexico. Mr. Lepelletier de Saint Remy says, "Samaná is one of those maritime positions not often met with in a survey of the map of the world. Samaná is to the Gulf of Mexico what Mayotta is to the Indian Ocean. It is not only the military, but also the commercial key of the Gulf; but the latter is of infinitely greater importance under the pacific tendencies of European politics."

The bay of Samaná being placed to the windward of Jamaica, Cuba, and the Gulf of Mexico, and lying moreover almost due N.E. of the great isthmus which now so powerfully attracts the attention of the world, the French author, just quoted, may well call it "*la tête du pont*" to the highway from the Atlantic to the Pacific.

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